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The Seventh Annual Meeting of the Mysore Agricultural and Experimental Union.

Welcome Speech

BY

Dr. Leslie C. Coleman, M.A., Ph.D.,
President, the Mysore Agricultural and Experimental Union.

MR. SREENIVASA IYENGAR, MR. HUMZA HUSSAIN, MEMBERS OF THE AGRICULTURAL AND EXPERIMENTAL UNION AND GENTLEMEN,

I have the honour of welcoming you to the Seventh Annual Meeting of the Mysore Agricultural and Experimental Union. Since we last met here the agriculturists of the Mysore State have passed through one of the severest times of trial they have ever had to face. Some of our taluks have, as a result of fodder scarcity, suffered a depletion of their live-stock unprecedented in the memory of the oldest agriculturists, a depletion which is certain to affect the agriculture of these areas for years to come. At our last annual meeting we discussed measures that might be taken for relief of fodder distress and all the measures recommended by the Union at that time have been attempted during the past. Some of them have met with a considerable measure of success, and have undoubtedly saved large numbers of valuable live-stock, others have been comparative failures but they have all taught us valuable lessons as to what practicable measures can be taken in the future should similar conditions recur.

At least two important facts must have been impressed upon us all during the past year. The first is the great necessity of regulating the number of our live-stock to our supplies of fodder. It is, I believe, an undoubted fact that this State is at the present time attempting to support a much greater number of live-stock than it needs and than its economically available fodder supplies can possibly warrant. Let us examine the actual state of affairs confining our attention to cattle alone and leaving out of account the very large numbers of sheep, goats and other live-stock to be found in the State. At the last Census of live-stock held in 1920–21 the total number of cattle was found to be 55 lakhs. Of these approximately 18 lakhs consisting of bulls, bullocks and male buffaloes, can be considered as available for draught purposes. For although a number of bulls and male buffaloes are not used in this way this number is offset by cows, which in some parts of the State are commonly used for draught purposes. We had at the last Census thus approximately 9 lakhs of pairs of animals in the State which could be used for draught purposes. If we deduct one lakh of pairs as being used *exclusively* for carting purposes, we have 8 lakhs of pairs for the cultivation of approximately 60 lakhs of acres. This allows $7\frac{1}{2}$ acres per pair of animals. One pair of moderately efficient bullocks should be sufficient for the cultivation of from 12 to 15 acres, which means that our agriculturists are at present feeding or should I say attempting to feed and keep alive, about twice as many draught animals as they should require. A similar analysis of figures for Kolar District—one of the districts most seriously affected by the recent fodder scarcity—shows that one pair of draught animals is maintained in that district to cultivate every 5 acres of land or about three times as many as should be required.

If we turn from draught animals to cows and female buffaloes we find that they numbered at the last Census nearly 24 lakhs. That means one milk-producing animal for every $2\frac{1}{2}$ members of our population. Were these animals able to produce on an average the modest quantity of one seer of milk per day we should have no complaint of an insufficient milk supply in the State. That they are not able to do so shows on the one side how badly they are fed and on the other how hopelessly inefficient they are. From the standpoint of producing progeny they are equally unsatisfactory.

The same Census shows the number of young stock as just over 13 lakhs. These young stock comprise animals up to three years of age and even if we allow for the reduction of young stock by sale and export out of the State it must be clear that our cows produce on an average less than one calf every three years.

From the above figures it must be clear that our agriculturists have been keeping almost double the number of cattle that they should require and that much of this surplus stock far from being an asset is a serious burden on the ryots of the State. The extent of this burden is brought home to us only in years of serious fodder scarcity such as the one through which we have passed, when lakhs of these surplus, and for the most part useless, animals have either starved to death or been sold to the butcher after they have assisted in practically exhausting the ryots' stocks of fodder.

It must be clear that we are here faced with a serious economic problem. Our aim must be a reduction in the numbers of our live-stock hand in hand with an improvement in quality. Nature with her rough but not unkindly hand has in a number of our taluks very summarily brought about a reduction in numbers in many cases far below the 50% limit. It is for us to use our best endeavours to see that the miserable specimens that have gone are replaced by animals which are an agricultural resource, not an agricultural burden. The Civil Veterinary Department is at present doing most valuable work in this direction by their castration campaign. The Amrit Mahal Department will, I hope, soon be in a position to do its part in the supplying of good breeding bulls. It is for you, gentlemen, to carry on an active campaign of education in the villages in this connection.

The second point which has been most painfully impressed upon us is the necessity of building up fodder reserves in the areas periodically affected by fodder scarcity. The process of reducing the numbers and improving the quality of our live-stock must, of necessity, be a very gradual one. Fodder famines such as the one through which we have just passed sweep away along with many useless animals many valuable ones as well and the necessity of building up in good years reserves of fodder which may be used in the lean years certain to recur has been most painfully brought home

to us. The question of storing fodder in the form of ensilage came up for discussion at our meeting last year. Thanks very largely to the active interest taken in this question by Mr. Zahiruddin Mecci, Deputy Commissioner, Tumkur District, a beginning has been made this year in the making of ensilage. Small areas of fodder crops, notably sunflower, have been set aside in villages in the Tumkur and Kolar Districts for the making of ensilage and an Agricultural Inspector with experience of the work has been placed on special duty to assist ryots in the making of the pits and the storage of the fodder. From this small beginning I am hopeful that we shall be able to develop an extensive system of fodder storage in taluks which are periodically affected by fodder scarcity. We are in a favourable position for this work as thanks to the munificence of His Highness the Maharaja we have already practical knowledge with regard to ensilage gained in the Palace Dairy Farm which, I believe, is unique in India.

I have taken so much of your time for a consideration of the fodder question because I greatly fear there will be a tendency, now that our fodder troubles are for the time being practically over, to forget the lessons which have been so painfully impressed upon us. You, gentlemen, who are here present may not have personally suffered during the past year but I would impress upon you as agricultural leaders the necessity of furthering in your villages by precept and example the storage of fodder as an insurance against lean years, and the improvement of our live-stock so as to enable us to do with one pair of animals work for which we now require two pairs.

Closely connected with the question of reducing the number and improving the quality of our cattle is that of improving our agricultural implements. An improved plough, for instance, requires a better pair of bullocks to pull it than does a country plough. On the other hand it enables the ryot to cultivate with one implement and one pair of bullocks an area for which he would require two or three country ploughs and two or three pairs of bullocks. The introduction of improved implements and the improvement of our draught animals must therefore go hand in hand. I do not propose saying anything more about our new Mysore plough to-day than to tell you that ploughs of this type have during the past year been sent out by us to almost all parts of India. The main objection

in Mysore to this plough is its price and efforts are continuously being made to bring the price down. These ploughs for which an order has been placed now will, I expect, sell at least five rupees cheaper than those we imported last year. This reduction in price has been possible largely because we could place a larger order and could combine it with a fairly large order sent by the Agricultural Department of the United Provinces. Our efforts to get ploughs of this type made in Mysore have progressed considerably and both the Bhadravati Iron Works and the Central Industrial Workshop are at present engaged in making ploughs of this type for testing. Should the tests prove satisfactory we shall, I believe, be able to develop a respectable local industry and at the same time give the agriculturists of the State a really efficient implement at a much lower rate than has been possible in the past. I have had brought to this meeting for the inspection of those who have not seen them the Mysore plough as made in England and the first sample received from the Bhadravati Iron Works. A demonstration of the working of these ploughs will be given on the Hebbal Farm at the time of our Field Day on Wednesday.

One of the important questions which will be discussed at this meeting will be that of manures. The attention which has been drawn to the importance of introducing selected high yielding strains of our staple crops must not be allowed to obscure the fact that given favourable seasonal conditions the yield of a crop must depend very largely upon the supply of plant foods in the soil. As I have pointed out on more than one occasion, the introduction of high yielding strains of crops must mean an increased removal of plant foods from the soil. If the plant foods so removed are not replaced through manures this seems almost certain to lead to a decrease rather than an increase of production. I am glad to be able to state that our agriculturists are beginning to pay greater attention to this important question but we have very far to go yet before establishing a really satisfactory system of manuring field crops in Mysore.

Another of the more important questions which will come up for discussion at the present meeting is the development of sericulture in the State. I think we are safe in saying that in no other part of India are conditions so favourable for the development of

this important agricultural industry as they are in Mysore. The work already done has shown quite clearly that Mysore silk can be brought to compete with the best that Japan or China can produce. The development of new and more efficient races of silkworms through breeding experiments has become an accomplished fact and this development seems certain to play an important role in the progress of rearing and reeling in Mysore.

The growing of mulberry and the rearing of silkworms is for the most part work for the small agriculturist. Neverthless I consider that members of this Union should use their local influence in fostering this important branch of agriculture. I would like to call your attention especially to the importance of developing sericultural co-operation in the State. As you will remember, at our last annual meeting we had a very useful and interesting discussion on the question of agricultural co-operation. Thanks very largely to the energy and enthusiasm of my esteemed friend Mr. K. H. Ramayya, Registrar of Co-operative Societies, there has been a very marked development in the utilization of rural co-operative societies for agricultural work during the past years. We have now nearly one hundred of these societies engaged in some form of agricultural activity such as the stocking and supply of seeds, manures and implements or the hiring out of jaggery boiling outfits owned by the societies. This work is, I am sure, bound to grow and I hope to see the day when every hobli of the State has at least one agricultural depot run by a co-operative society.

There are two phases of agricultural co-operation which I think just now require our serious attention and I hope we shall have an opportunity of discussing them at this meeting.

The first of these is, as stated, sericultural co-operation. This subject presents certain special difficulties as it has to do with small men, quite commonly tenants in the case of silkworm rearers and men under the control of dealers in the case of the reelers but I believe a practicable scheme can be worked out and I trust we shall have an opportunity for full discussion of this subject at the present meeting.

The second phase of agricultural co-operation is connected with the growing of new and better varieties of cotton. As you may be aware the Agricultural Department has during the past seven or eight years been engaged in an attempt to develope improved

strains of cotton to replace the mixtures now being grown in the State. One of our selections is at present being grown on an area of about 1,500 acres. Our problem is on the one side to prevent mixing of this cotton with the ordinary cotton at present sent to the gins so as to ensure for the growers the enhanced price for quality which the better product should bring them and on the other hand to prevent the mixing of seed at the gins so as to keep our new strains pure for distribution over much larger areas. Experience in other parts of India seems to indicate that these ends can best be attained through co-operative effort and it is certainly quite clear that it will be quite impossible for the Agricultural Department with its comparatively small staff to supervise this work.

Before I close I should like to refer to one other matter. That is the question of the formation of colonies for men who have had agricultural training. This Union at its last meeting prepared a scheme for the establishment with Government aid, of colonies which on the one hand would give opportunites for men who have undergone agricultural training to make practical use of that training and on the other hand would form centres from which agricultural improvements may be expected to spread.

The problem of employing with profit to the State our young men who have had special training is one affecting not only our Agricultural School but practically all our higher institutions. We have still in the State fairly large areas of land which can be profitably brought under cultivation and a part of this land can be utilized to form colonies. I would draw your attention to a somewhat similar scheme which has been developed in Canada with the object of settling returned soldiers on the land and this scheme has, according to reports, been a pronounced success.

Our scheme is now before Government. It has been favourably reported upon by a Committee of the Agricultural Board and I sincerely trust that it will receive sympathetic consideration on the part of His Highness' Government during the coming year.

Before closing I should like to extend a special invitation to those present to-day who are not members of our Union to attend our Field Day on the Hebbal Farm on Wednesday. The field Day is a unique feature of our annual meeting. On that day the Agricultural

Department and our Union are At Home to all interested in agriculture who will come. In addition to the opportunity given on that day to inspect the various experiments which are being conducted on field crops on the farm we are to have a small cattle show at which the progeny of our Farm drawn from the neighbouring villages will compete for prizes. We are also to have a demonstration of improved ploughs and other implements.

I believe that a visit to our oldest Experimental Farm is almost a necessary part of education of any one interested in agricultural improvement. One of our members, Mr. V. K. Badami, who is at present doing research work in Plant Breeding in England and who has during the past summer had exceptional opportunities of studying work in experimental farms in Europe, informs me that our Hebbal Farm will bear comparison with the best that he has seen. There has been much rather loose comment upon Experimental Farms and how they should be run. I should like to have an opportunity of showing every one present here just how our experimental work is being carried out.

The Mysore Agricultural and Experimental Union, Bangalore.

ANNUAL REPORT FOR 1924.

BY

N. Venkatsubbaya,

Secretary, The M. A. & E. Union.

I have much pleasure in submitting for your consideration the Seventh Annual Report of the Mysore Agricultural and Experimental Union.

Constitution of the Union.—The Mysore Agricultural and Experimental Union is a body of agriculturists, its members being members of the executive and scientific staff of the Mysore Agricultural Department, ex-students of the Mysore Agricultural School and experienced farmers of the State.

Union, the natural Outcome of Work of the Agricultural Department.—The Union may be said to be the natural outcome of the work

of the Agricultural Department. When after a series of years of continuous experiment in the laboratory and on the field the investigations of the Agricultural Department begin to yield reliable results, the Department will have to organize the testing of the improvements indicated by its investigations under the varying conditions of soil and climate obtaining in the area it serves. This testing is best done on the ryot's own land, both because that would furnish the best demonstration possible to the farmer of the suitability or otherwise of a recommendation and because the ryot's land is the only place where the suitability of a suggested improvement for his soil and climate can best be tested. In order to conduct tests of improvements the farmer must have intelligence and some training. Now when the Union was started in 1918, all these requirements may be said to have existed. The Agricultural Department had definite recommendations to make to the farmer as a result of nearly fifteen years of experiment. It had a faithful band of co-operators from among the farmers some of whom at least had both the intelligence and experience to carry out small tests on their lands. The organization of the Agricultural School in 1913 further provided a trained band of agriculturists who could be depended on for co-operation in this kind of experimental work. An association which would bring together all these agriculturists who could continue this necessary part of the Department's work outside its farms would, therefore, serve a very useful purpose. The Union, therefore, came into being none too soon.

Its main Activities.—The programme of work of the Union has mainly consisted of experimental work of various kinds from the beginning. In order to provide a means of communication among its members and to provide the kind of agricultural education that the printed page can furnish, a Quarterly Journal was started in 1919. To cater to the requirements of its non-English knowing members and the general public, a Kannada edition of the Journal was organized a year later. In addition to these means of communication, an annual general meeting is being held for the discussion of tests conducted by members and of other subjects of outstanding agricultural importance. During these meetings a morning is usually spent by members in going through the laboratories of the Department in Bangalore and a day—usually the last one—is spent on the Hebbal Farm in studying the experiments being conducted there. These items help to keep the

members in thorough touch with the work of the Agricultural Department.

Its Experimental Programme.—The simplest kind of experiment which could be taken up by an agriculturist to start with is perhaps the testing of an improved variety of seed of a crop he usually grows on his land. We started in 1918 with trials of improved strains of seeds of our chief staple crop—ragi. Improved varieties of other crops, manurial tests, etc., were added on in subsequent years. Agricultural implements, insect pests and plant diseases, sericultural experiments, all these find place on our programme.

I shall now briefly discuss the results of trials made in 1922 and 1923. The results of trials, excepting that of ploughs, made during this year are not available for discussion, as the harvest of crops is yet to come.

Results of Tests—Ragi Varieties.—In Bangalore H43 has given the best yield, H40 closely following it, and H22 holding the 3rd rank. In Doddaballapur H40 has done best, H2 and H43 closely following. In Maddur taking the different places in which tests were made, the results are not very conclusive in favour of any one variety. H40 stood first in one place, H2 and H40 stood bracketed first in another place.. H43 did best in the third place and in the fourth place the famous old H22 asserted itself. In Chintamani, in both the places where tests were made, H22 was not beaten by the newer varieties. The same was the result at Siddlaghatta where H22 stood an easy first, H13, H39 and H44 stood next. One point which has been noted here is that while H22 takes from 8 to 15 days more than the local variety to come to maturity, the other Hebbal selections can be harvested at the same time as the local variety. Among these H13, H39 and H44 have each given a yield of a palla more per acre than the local variety. This feature, *viz.*, early maturity, is all in favour of these other varieties. The point was confirmed by results of trials during the next season. Another point which has come to light in Siddlaghatta and in some other places also is that many of these new varieties resist drought better than the local varieties.

In Mysore H43 did best giving an yield of nearly 9½ pallas per acre on experimental plots as compared with about 6½ pallas per acre of the local variety. The other varieties which did well were H13 and H39. Every one of the new selections excluding H33 and

H44 gave appreciably higher yield than the local variety. In Sabbanahally, Goribidnur Taluk, H40 and H43 did best, H44 closely following. In Tumkur, in one place H22 stood first, H44 and H33 coming next in order of merit. But in another place H22 and H33 did equally well. In Maddagiri H43 did best.

Judged by these results, H43, H40 and H2 seem to be very promising in addition to H22 which is now very widely being grown by ragi growers. The latter variety has so completely displaced the local varieties that in some of our experiments the newer varieties were compared with it as the local variety.

Unfortunately there were not as many successful experiments in 1923 as there were in 1922. The few successful ones demonstrate the drought resisting character of some of the new selections.

Groundnut Varieties.—Out of three varieties of groundnuts tested in Tumkur district in three places, the Mauritius variety has done uniformly well. Sogatoor did nearly as well in one place and stood first in another. In Maddagiri the Barbados variety appears to have done far better than the other two varieties tried, *viz.*, Sogatoor and Transvaal. The former stood second.

In Maddur, Sogatoor did best, Carolina closely following. In Doddaballapur, Mauritius did distinctly better than the other two varieties, *viz.*, Carolina and Sogatoor. The 1923 tests with groundnuts were practically all failures.

In the light of these results, he must be a bold man indeed who can dogmatize that he has a variety of a crop which will do well anywhere.

Castor Varieties.—Tests of castor varieties are not sufficiently numerous for purposes of comparison. These tests will have to be carried out in larger numbers and in more places than now for any definite results to be obtained.

Sugarcane Varieties—Seedling Canes.— In the sugarcane varietal tests at Sabbanahally, Goribidnur Taluk, in 1920, out of six varieties tried H. M. 544, H. M. 312. H. M. 310 and H. M. 303 did well. H. M. 14 and H. M. 315 fared badly and were rejected for next planting. The next year, *i.e.*, 1921, H. M. 544 and H. M. 310 did better than the local, the former giving some 70 maunds more jaggery than the local, and the latter giving ten maunds more per acre. These two varieties were grown on a large scale the next year, *viz.*, 1922. But the trial

of newer varieties was continued. As many as seven new varieties were put down in trial plots. The results obtained after harvest in 1923 showed that in point of yield of jaggery H. M. 320 stood first giving as much as 75% more jaggery than H. M. 544 and nearly a 150 % more than the local. This is an example of an ideal farmer who is never satisfied with what he gets out of his land, and who is always on the search for newer and better things—an example which deserves to be largely emulated.

H. M. 544 and H. M. 312 did well in 1921 at Ooragahally. H.M. 314 was found poor and was rejected for next planting. The next year's test resulted in H. M. 544 and H. M. 320 doing well. Each of these canes gave more than 300 maunds of jaggery per acre in the places where they were tested. H. M. 312 though found to be a vigorous cane was found to lodge badly. It happened that in many of these tests the canes which did best were not crushed but reserved for seed and so comparative yield of jaggery could not be obtained. There is also the fact that during transit a considerable proportion of the canes lose their eye-buds, particularly so in the case of H. M. 544 cane, so that the portion which reaches its destination safe will not be enough for planting the experimental plot. In such cases the experiment can be laid out only during subsequent years.

Sugarcane Manurial Tests.—Manurial tests on sugarcane with ammonium sulphate were started in 1921. Experimental plots were laid out in 14 places. Results of some of these tests obtained after harvest of the crop in 1922 were published in the Journal. In view of the results of these tests some prominent sugarcane-growers in the State purchased and applied ammonium sulphate for large areas during the next year.

Paddy Manurial Tests.—Paddy manurial tests with ammonium phosphate have been started this year.

Trial of Implements.- A few comparative trials with improved ploughs such as the Syracuse, the Kolar Mission and the Verity were made in 1919. The results indicated that these ploughs which were made for conditions different from our own could not be expected to work efficiently under our conditions. The Department conducted its own trials meanwhile and evolved a plough which combined the good features of design and economy of foreign ploughs in use in the State. A few ploughs were given out to members for trial in 1920.

Improvements were made in the light of experience in subsequent years. Two hundred ploughs of the design as finally approved were manufactured by Messrs. Ransomes Jeffries of England for the Department. The first consignment of these ploughs arrived too late in the season to be tested last year. A good number of them have been sold out, a fair number to our members. Members who have used them will, I hope, report results to this meeting later on. The problem with regard to this plough now seems mainly to be that of making it available for sale at a comparatively cheap price.

Work on Cocoanut Beetle.—Our Vice-President Mr. H. Srinivasa Rao has been conducting experiments on the control of the Cocoanut Beetle for the last five years. His reports in regard to the work have appeared from time to time in the Journal.

Koleroga of Coffee.—Spraying against Koleroga of Coffee was started last year. Mr. T. Narasinga Rao gave an account of his experiments to the annual meeting last year. He has conducted the experiment this year also and will, I hope, give the results to this meeting. Four of our members have done this work this year.

Sunflower Ensilage.—Sunflower was grown for being made into ensilage but due to the bad season the crop was not sufficient in bulk for the purpose. It was therefore allowed to seed. A few members have grown it again this year, and one of them has just put the stuff in a silo pit.

Sericultural Experiments.—Sericultural tests with regard to rearing silkworms and reeling silk were first included on our programme last year. The results will probably be given to this meeting.

Lessons from the Results of Tests.—While the results of these experiments, whether successful or otherwise, have been of use to the experimenter individually in finding out the best seed or method of cultivation for his land and while they must have been of use to the Agricultural officer of the locality in indicating the improvement he might try to introduce in his range, they have demonstrated the fact that it is never safe to adopt a suggested agricultural improvement on a large scale without trying it first on a small scale on one's own land.

Ambitious items on Programme—Maintenance of Farm Accounts.—There is one item on our programme about which I cannot resist the temptation of saying a word. I refer to the maintenance of farm accounts. Everybody, even including the farmer himself, seems to

realize the immense importance of maintaining some sort of farm accounts. There is no doubt that many farmers do maintain some sort of an account. The general body of the Union approved of some model forms (in 1921) which were published in the Journal. Ever since, a few members have been agreeing every year to maintain accounts on the model but not one has furnished results. Once we included on our programme the subject of collection of economic statistics. In the light of subsequent experience we dropped it out from the subsequent year. We tried to collect statements of crop returns. Just one member gave figures. For my part, I would take these failures as indications that there is little use in making our programme ambitious. I would recommend dropping the subject of Farm Accounts altogether from our programme.

The Ontario Agricultural and Experimental Union.—During these six years 506 tests have been undertaken by our members. A hundred members have taken part in this work. These figures as compared with the work done by the famous Ontario Agricultural and Experimental Union are insignificant but very suggestive. The Ontario Union has, according to one of its reports, conducted 1,00,801 distinct tests during a period of 37 years. The number of experimenters with farm crops actually engaged in the work has varied from 1,616 to over 5,000 annually within the last thirteen years. These co-operative experiments were organized in Ontario soearly as 1886. Curiously enough during the first year twelve farmers volunteered to co-operate in this work in Ontario—just one less than the number of members who undertook work in 1918 when we started. From this small scale the work in Ontario has developed to the dimensions represented by the figures already mentioned. It looks as if we are now in almost the same state that the Ontario farmer was in 1886, that is to say about 40 years out of date, but the fact will have to be borne in mind that agricultural departments and field experiments are comparatively of very recent origin in this country. There is the further fact that the standard of literacy among our farming population is exceedingly low. Our membership is drawn from among the more intelligent portion of farmers. But the fact that 45 is the maximum number of experimenters in any one year out of a total of some 220 non-official members, tempts me to ask if these figures represent the extent to which absentee landlordism has invaded our ranks. I do not wish to push the observation further.

Failure due to Season and Want of Attention.—It must not be imagined that each one of these 504 tests undertaken by members has been carried out to a successful conclusion. A considerable number of these were failures due to adverse seasonal conditions—particularly so in 1923. In a few cases sufficient care was not taken in measuring the yields from experimental plots so that the results have no value as experiments. In other cases the trial was made only during one season so that the results obtained are not conclusive as the influence of the season on the results remains undetermined.

We are Improving.—Mistakes have been made and we are none the worse for making them. The work is getting better organized year by year. The following appreciative remarks made by one Inspecting Officer as regards the way the experiments are being conducted indicate that our members are getting trained rapidly. The officer wrote as regards experiments conducted in 1920 : "New varieties of ragi from the Hebbal selections were also tried on a small scale in different places. The areas put down were too small for experimental plots and the results could not be considered striking." The same officer referring to the tests conducted in 1922 wrote : "The way in which the plots were laid out and the cultivation attended to was worthy of all praise. Most of them (members of the Union) have taken great pains in carrying out the work successfully and have also reported results." Referring to the experiments laid out in 1923 the same officer remarks : "Varietal tests of ragi were arranged for in all Ranges and with the same painstaking care by many but unfortunately with two exceptions, all were failures owing to drought." All these denote that our members are fast improving and that one of the main objects of the Union, *viz.*, that of training our farmers in methods of small field experiments, in other words "self-help", is being steadily realized.

Difficulties in the way of Extending Experimental Work.—The work is getting organized. We send out now with material for experiments detailed instructions as regards laying out plots, etc., and supply forms on which results are to be returned. The main difficulties in the way of extension of this work on a large scale seem to be that of (1) want of sufficient funds in the departmental budget for this work and (2) better organization of our efforts. It is not necessary for me to point out that the results of these tests conducted

by our members are really more useful to the Department than it appears. The Department finds out through *one* person what is suitable to *many* and as such must be prepared to spend adequately in proportion to the importance of this work. The importance of our work has been recognized by no less a person than our Dewan Sahib himself, for he said addressing our meeting in last December :—

"It is undoubtedly to the advantage of Mysore Agriculture that any propaganda work or work relating to definite improvements based on experiments made under various agricultural conditions should be performed by those who are directly connected with the land and it is by their efforts only that the work of the Agricultural Department can be proved to the hilt for ready acceptance by the ryots. It is not possible for Government to make these experiments on a large scale by the establishment of experimental farms in each taluk. The lessons learnt at the Government Demonstration Farms can be picked up by Experimental Unions such as the one you have formed, and in the long run it would be more economical to Government to introduce a system of Government subsidies and grants for Experimental Stations set up by agriculturists in the different parts of the State on the co-operative basis rather than open Government Farms as is sometimes urged by the members of the Representative Assembly. I therefore suggest that you may go into the question of having more than one Agricultural and Experimental Union organizing, say to begin with, one for each District, to make experiments in their own holdings in respect of main food crops as well as the industrial crops under the guidance of the Agricultural Department on a co-operative basis, if necessary ; and if such organizations are set up, I shall earnestly consider the question of giving substantial financial help to such organizations to give them additional inducements and encouragement."

On our part, I feel we must organize our work better during the coming year. There is perhaps no need of more than one Agricultural and Experimental Union, for we can branch out as widely as there is need. I think we should for the present soon have a small sub-committee of our members in each Agricultural Range with the local Agricultural Inspector on the committee. A committee of just three or four members will quite do. A committee such as that can better organize experimental work in the Range than the central

committee can and it should also be able to enlist more members to the Union and subscribers to our Journal. I offer this suggestion for your consideration at this meeting.

Colonization Scheme.—Before I pass on to other matters in which non-members may not be interested I wish to refer briefly to a subject in which the Union though not directly concerned, has interested itself. I refer to the Colonization Scheme.

The object of the scheme is mainly to afford facilities to trained men coming out of agricultural institutions to settle down on land. The scheme was drawn up by an expert Sub-Committee of the Union and discussed thread-bare at our General Meeting, in May 1918. It was considered again at our annual meeting last year, and as decided then it was sent up to Government for their sympathetic consideration. It is hoped that Government will see their way to sanction the scheme very early.

Address by K. R. Srinivasiengar, Esq., M.A.,

Member of Council.

Dr. Coleman, Members of the Agricultural and Experimental Union and Gentlemen,

I greatly appreciate the honour you have done me in asking me to preside at the opening of the annual meeting of the Mysore Agricultural and Experimental Union. Though, as Member of Council, I am not at present in close touch with the work of the Agricultural Department, I may say that, as an officer whose service extending over three decades was mostly spent in the Revenue Department, I have always taken a deep interest in the agricultural development of the country. As Deputy Commissioner of Kadur, I started an Association in the District which included among its members the leading agriculturists of the District and which, as Dr. Coleman is aware, did some amount of useful work, somewhat on the lines of this Union, though on an humbler and smaller scale. In the Districts of Bangalore and Tumkur also, wherein I served as Deputy Commissioner, I brought into existence similar Associations to co-operate with the Department in the popularization of improved agricultural implements and improved methods of Agriculture. As Revenue Commissioner and member of the Agricultural Board,

and for sometime its chairman, I have had to investigate and discuss with the Director of Agriculture problems relating to increase of food production in the State, the standard outturn of the several crops and other subjects common to the Revenue and Agricultural Departments. It was, therefore, with feelings of great pleasure that I accepted the kind invitation of Dr. Coleman to meet you to-day and hear your views on some of the important agricultural problems mentioned in your programme.

The scientific study of agriculture and the investigation and adoption of improved agricultural methods in Mysore are of comparatively recent origin and practically date from the appointment of Dr. Coleman as Director of Agriculture : for though before that, some amount of work was done under Dr. Lehmann as Agricultural Chemist, it was mostly in the laboratory and there was very little practical field work undertaken in his time. Though the Department has been in existence for only about 15 years, it has, owing to the earnestness, zeal and high capacity of Dr. Coleman, made such rapid progress during the period as to win the admiration of every administration in India. At the Meeting of the Board of Agriculture in India held in Bangalore in January last, Mr. Milligan, Agricultural Advisor to the Government of India, who was President of the Board, spoke of our Agricultural Departmental Officers in the following terms : -"No Department of Agriculture is more highly thought of than that of Mysore and no members of the Board are held in higher esteem than the delegates from this State. The Mysore Agricultural Department has achieved fame not only by its practical methods of applying scientific knowledge and technique to the solution of its agricultural problems but also by the marked success which has attended its efforts. The annual value of the improvements introduced now amounts to several lakhs of rupees and thus the expenditure on the department is returned to the soil ten times over. This Board is at times a somewhat critical assemblage ; but it recognizes, as far as Mysore is concerned, that the Agricultural Department is tackling the right problems in the right manner." His Highness the Maharaja who presided at the opening of the meeting of the Board was also graciously pleased to express his appreciation of the excellent work done by the Mysore Agricultural Department under Dr. Coleman assisted by a band of highly qualified and capable officers. These

high words of praise coming from such distinguished personages should be a peculiar source of pleasure to Dr. Coleman and his officers; and I take this opportunity of offering them my congratulations on the distinction achieved by them.

One sometimes hears criticisms levelled against the Agricultural Department by persons who have no knowledge of the work done by it and who say—"What is the need for such a costly Department? What has the Department done for us? Why should it not be abolished?" One or two such voices were raised even in the recent sessions of the Representative Assembly; but they were drowned in the chorus of disapprobation with which they were received by the remaining members. Critics of this kind fail to realize that the development of scientific agriculture must necessarily be slow and gradual, as agricultural experiments, *e.g.*, in regard to the use of particular kinds of manure or seed, or the prevention of particular plant diseases, have often to be conducted over long periods before any success can be claimed for them. It has also to be borne in mind that even when the Department is convinced of success of any of the experiments, it is not always an easy thing to induce the raiyats who are by nature sceptical and conservative, to adopt modern scientific methods of cultivation, particularly if they happen to entail some additional cost as most of them genrally do. Notwithstanding these difficulties, it is to the great credit of the Department that it should have, within the short period since its activities were commenced, been able to claim that by the popularization of improved methods of cultivation, the supply of select varieties of seed grains, etc., the production has been increased and the raiyats have been benefited to the value of not less than 10 lakhs of rupees annually as explained by Dr. Coleman in his Address to the Union in 1921.

Highly successful and praiseworthy as the development of agriculture in the State has been in the past, the Department cannot afford to rest on its laurels. There are still innumerable problems which are awaiting solution and which require the unremitting attention and study of the Department and its officers.

One of the most important of these problems is that of increasing the food production of the State. To what extent we are dependent on foreign market for some of our staple food grains, particularly rice, will be evident from the fact that according to the trade statistics

furnished by the Industries Department, we are importing annually nearly 12 lakhs of maunds of rice valued at about a crore of rupees and about 2½ lakhs of wheat and wheat flour worth about 25 lakhs of rupees. Even in respect of dry food crops, such as ragi, jola, etc., our production in *normal* years is just sufficient to meet our demands; while in years of scanty rainfall and unfavourable seasonal conditions, it falls far short of our requirements. The Season and Crop Report for the year 1922–23 shows that the total production of paddy in the State during the year was about 35 lakhs of pallas (or 17½ lakhs of pallas of rice) for an area of 7 lakhs of acres under the crop, giving an average of about 5 pallas per acre; while the yield of ragi and jola amounted to 52 and 12 lakhs of pallas for an area of 23 and 7 lakhs of acres respectively, giving an average of only about 2¼ pallas of ragi and 1¾ of jola per acre. The total yield of these staple food crops, rice, ragi and jola for the State thus amounted to only about 80 lakhs of pallas for the year against a probable annual demand of 100 lakhs for a population of 6 millions at the average rate of ½ seer per head per day. The insufficiency of our food production and our dependence on foreign markets was well exemplified and prominently brought to notice during the food scarcity season of 1918-19 when we had to indent on Burma rice in very large quantities to make good our shortage and tide over our difficulties. The Government, with the help of the Agricultural Board and the Revenue and Agricultural Departments, have considered several schemes for the increase of food production and sanctioned the grant of lands on favourable terms for the purpose; but I do not think that the results have come up to expectations. Government may provide the agricultural classes with any extent of additional land from the large reserve of waste lands still remaining at their disposal; but the mere provision of land alone cannot bring about an increase of food cultivation, as the expansion of cultivation depends on various other factors also, such as labour conditions, the need for capital, the productive capacity of the land, etc. Even in respect of the lands already in the holding of the raiyats, the natural tendency for them is to raise such crops thereon as are most paying and to restrict the cultivation of food crops to the minimum extent required to meet their personal wants. If, therefore, the raiyats are to give preference to the cultivation of food crops, it should be made as profitable or

remunerative for them as the cultivation of commercial and other crops ; and this can only be done by intensive cultivation, by the adoption of improved and labour-saving implements and machinery, the improvement of the soil either by the use of suitable manures or other scientific methods, the popularization of high yielding varieties of seed grains, and the adoption of other methods calculated to increase the productive capacity of the soil. The Agricultural Department has, no doubt, done considerable amount of work in past years in every one of these directions ; but the progress achieved so far is nothing compared to what still remains to be done.

Besides rice and wheat which I have referred to already, we are now importing to our State from outside, raw cotton of the value of 59 lakhs of rupees, tobacco valued at 30 lakhs, refined sugar valued at 16 lakhs, turmeric for 2 lakhs and castor for $1\frac{1}{4}$ lakhs. With the varieties of soil, climate and rainfall in our State and with the large area of arable lands (to the extent of nearly 8 lakhs of acres) still available for occupation, there is no reason why with sufficient enterprize on the part of our raiyats, guided and advised by the Agricultural Department, we should not produce not only all the food required for our consumption but also all the industrial crops required to feed our factories instead of importing them largely from outside.

Speaking of sugar, I may make a reference here to the Company which is being now floated under the direction of Messrs. Battersby & Co. of Calcutta, for the establishment of an extensive and up-to-date sugar factory under the Sulekere tank in the Shimoga District. Our best wishes naturally go to the success of the enterprize as it will give a great impetus to the cultivation of sugarcane and the development of sugar industry in general, in the State.

I may refer here to the extremely beneficent and useful part played by the irrigation wells in promoting production and in relieving distress, particularly in seasons of drought or scanty rainfall. In some of the dry taluks of the Tumkur District, as Sira, Maddagiri and Pavagada, I have observed that when the whole country looked parched up and dry, the only green spots to be seen were those under the irrigation wells, like oases in a sandy desert. The importance of irrigation wells as a protection and insurance against famine in

places wherein conditions were favourable for their construction had long since been recognized and a liberal system of takavi loans was sanctioned therefore during the Dewanship of Sir K. Seshadri Iyer who placed some Assistant Commissioners on special duty for the administration of the loans during the distress of 1892–94. Most of the wells that were then constructed with the aid of these loans have since fallen into decay and have not been replaced by others. The recent drought having emphasized the need for giving particular attention to the revival of these wells. very liberal grants have been sanctioned by the Dewan for the grant of loans for this purpose during the current year and a specially trained staff equipped with well-boring appliances has also been appointed and placed under the Director of Agriculture to help the raiyats in the construction of these wells. It is hoped that these measures will bring about ere long a marked increase in the number of these wells and serve to largely mitigate the sufferings of the people in these tracts in future seasons of drought and scarcity.

The question of stocking a sufficient supply of fodder for saving the cattle which form the most important asset of the agriculturists in seasons of drought, is another matter to which attention has been prominently drawn during the recent drought when various expedients were tried to tide over the difficulty. These were, however, more or less of the nature of experiments and make-shift arrangements. The solution of the general question is not an easy one and is beset with great difficulties. Before achieving any measure of success in solving the question, there is a great deal of experimental and demonstrative work to be done in the direction of the larger production of *sunflower* and other drought-resisting and quick-growing varieties of fodder, preparation of prickly pear and other plants for use as fodder during seasons of drought, the formation of fodder preserves and the general use of *silos* by the agriculturists, and I have no doubt that the matter will receive all the attention that its importance deserves at the hands of the departmental officers as well as the members of the Union.

A subject closely allied with the subject of fodder is that of the improvement of agricultural stock. Mysore has always been famous for its cattle and this reputation is maintained even at the present day as evidenced by the large number of persons who come from

outside to purchase our cattle at the local fairs and jatras such as those held at Chunchinakatte, Ghati Subramanya, etc.

The Government have been rendering every help and encouragement towards the maintenance of the good strains of cattle by the supply of breeding bulls at nominal prices. Recently, Government have reorganized the Veterinary Department and have also appointed a Live-Stock Expert and transferred the control of the *Amrit Mahal* Department to that of Agriculture. Some very interesting experiments have been carried out with reference to improvement of milk strain in the Palace Rayanakere Farm and I am sure that the members of the Union will eagerly watch the results and will be the first to translate the results of such experiments into the field of practical activity. You may remember that Mr. Bowring, when he was Deputy Commissioner of the Kolar District, started sheep breeding in the District in the earlier days of the activities of the Economic Conference and I understand that the results of the experiment were encouraging. The development of sheep breeding is receiving attention at the hands of the Live-Stock Expert and I am glad to hear that some members of the Experimental Union are co-operating with him in giving effect to his valuable suggestions. The Government of India have recently organized the *Imperial Dairy Institute* at Bangalore and I am sure the members of the Experimental Union will avail themselves of the opportunity of their presence here to visit this Institute and find out how far the work that is carried on there can usefully be adopted by them.

Even with all our efforts at increased food production, it is necessary that, if we are to successfully tide over a season of drought and crop failure, there should be always sufficient stock of food-grains in the State, to last for a year, if not more. One of the ways in which this can be done is by the formation of *Grain Banks* in each village which should gradually be built up so as to contain at least twelve months' supply of the food-grains required for the consumption of the village.

This idea having been forced on me by the food scarcity of 1918–19, I communicated it to some of the Deputy Commissioners with the result that one of them—Mr. Zahiruddin Mecci– took it up enthusiastically and with his characteristic zeal tried to give practical effect to it in the District of Kolar of which he was in charge. But

unfortunately his work in this direction did not yield any abiding results as, in the absence of a definite policy and a set of rules recognized by Government, the success of the experiment depended entirely on his individual effort and personal interest and, with his departure from the District, the matter did not receive sufficient attention at the hands of his successors as well as the other officers in the District. Mr. Mecci had, I believe, also sent up to Government a set of draft rules, etc., for the formation and management of these grain banks in each village on a co-operative basis ; but I do not know how the matter was disposed of. I would commend the subject for the earnest consideration of the members of this Union and ask them to take up its investigation in consultation with the officers of the Agricultural, Revenue and Co-operative Departments with a view to such action being taken as may be considered feasible and practicable.

In this connection, I am reminded of a Co-operative Grain Bank which was started in the village of Kotta in the Sira Taluk (Tumkur District) when Mr. M. Shama Rao was the Deputy Commissioner of the District and for which I remember having obtained a Government grant for the construction of a granary for storing the grain when I was in charge of the District. It will be interesting to know, and I shall be glad, if any of the members of the Union could furnish the information, as to whether this Bank is now in existence and how it has been working.

This brings me to the question of adoption of the co-operative principle in general in connection with agriculture. There is any amount of scope for the formation of Agricultural Co-operative Societies, for co-operative farming with the use of machinery (as in the case of pumping installations run on co-operative lines at Yelladabagi and Kuntegowdanahalli in the Sira Taluk), the purchase and supply of seeds, manures, etc., for the use of the members and for the marketing of agricultural produce. Most of you are aware to what extent the paddy growers of *malnad* are dependent on the *Mapilla* and *Labbe* merchants who purchase the standing crop at very low rates by advancing money thereon and make large profits by its sale. Many of the *arecanut* growers in *malnad*, and probably the cotton growers in the Chitaldrug and other Districts, are also labouring under similar disadvantages. It will be the salvation of these persons

if co-operative societies could be formed for advancing money to the needy cultivators at an easy rate of interest on the security of their crop and getting the best possible price for the produce after its harvest. It is a matter for regret that while the co-operative movement has made very great progress in the State so far as ordinary credit societies are concerned, there has not been any appreciable progress in the development of agricultural co-operation, the number of purely agricultural co-operative societies that has been formed so far being perhaps not more than about a dozen or two all over the State. (I am glad to learn from the Registrar now that the number of such Societies is about 40.) It seems to me that special attention should be given to the organization and development of Agricultural Co-operative Societies and that it will be well if a few Co-operative Inspectors are specially told off for this work and placed, if necessary, under the control of the Director of Agriculture for the purpose.

One of the chief obstacles in the way of improvement of agriculture not only in our State, but generally in India, is the large number of small holdings. It does not require much argument to convince anybody that 10 acres of land situated in a compact block can be far more effectively cultivated and be made to yield much better produce than the same area spread over 20 different plots scattered all over the village. The fragmentation of holdings has been chiefly due to our laws of succession and partition of property ; and their consolidation, however much it may be desirable, is a question of no small practical difficulty. The problem is, however, worth seriously considering with a view to arriving at a practical solution, if possible. I believe that, in the Punjab, the question of the consolidation of holdings has been taken up by the Co-operative Department with a considerable measure of success and I do not see why it should not be given a trial in our State. It is my recollection that when I was on the Agricultural Board as Revenue Commissioner, there was a proposal made by the Board to have the system tried in a few typical villages. But I do not know in what stage the matter stands at present. I would suggest that the question may be discussed by this Union and their well-considered opinion thereon, after viewing it from all standpoints, sent up for the consideration of the Director of Agriculture and the Government.

The statements of standard outturn of crops which are now

adopted by Government have been prepared on crop experiments made (or supposed to have been made) years ago by the Revenue Department in the several taluks. But they are far from being reliable and satisfactory. It is, I think, the function of the Agricultural Department to obtain and collect reliable statistics of the standard average outturn of each crop in any local area. In this work, the members of the Union can render useful service by undertaking experiments on small plots in their holdings and reporting the result to the Department for tabulation and compilation.

I have so far touched briefly only on a few of the important problems which, in my opinion, deserve the consideration not only of the Agricultural Department but also of this Union as well as of all persons interested in the agricultural prosperity of the State. The subject is, however, one of vast magnitude and importance, and there are so many questions that demand attention that it is impossible for me to enumerate them in detail or do justice to them within the limited time at my disposal, even if I had the special knowledge required to deal with them, which, I must confess, I do not possess.

In almost every one of the lines of work which I have mentioned, and particularly in the conduct of experiments and demonstrations, the members of this Union can do signal service by active co-operation with the Department. However successful any improved agricultural implement or improved method of agriculture adopted on Government experimental and demonstration farms may be, it does not carry conviction to the ordinary agriculturist as he is always suspicious about the reported success of Government undertakings and is prone to think that while it is easy for Government to achieve successful results with the unlimited resources at their command, it will be impossible for private individuals to obtain the same results with their small and limited means. The only way in which such suspicion and distrust on the raiyat's part can be overcome and conviction carried to him is by the demonstrations being carried out before his eyes on the farms of his neighbours. The more therefore the members of the Agricultural Union co-operate with the Department in undertaking experimental and demonstration work on their own lands, the more will they contribute towards the rapid agricultural progress and development of the State. From the very interesting report just now read by the Secretary, it is gratifying to observe

that the members of the Union are fully alive to their obligations in this respect and that they have undertaken and carried out various experiments and demonstrations in connection with the cultivation of different strains of ragi, paddy, sugarcane, groundnut and other crops, the uses of different kinds of manures, the prevention of *Koleroga* in coffee, the uses of improved ploughs and other agricultural implements, the use of *sunflower* for fodder, etc. The experiments have, however, so far been confined only to a few members, the average number of members undertaking experimental work amounting to not more than 40 a year. In addressing the Union as President in the year 1921, Dr. Coleman stated that he looked forward to the time when we shall have members in every Hobli in the State who will be carrying out such tests in co-operation with the Agricultural Department. Far from having a member in each Hobli to carry out tests, it is disappointing to observe that, though the Union is now running into its 8th year, the total number of its non-official members, whether carrying out agricultural tests or not, is only 227, the Districts of Shimoga and Chiltaldrug being very poorly represented on it, contributing as they do only 14 and 6 members respectively. Even if the Union had one member for each Hobli as forecasted by Dr. Coleman, its strength should be treble its present number. The poor strength of the Union may perhaps be due to the difficulty of a central Union with its head-quarters at Bangalore reaching the agriculturists in the distant mofussil Districts. The question of having either branches of this Union or forming separate Unions in each District as suggested by the Dewan in his address to you last year, deserves, therefore, to be taken up by you as early as possible, especially as he has very kindly offered to earnestly consider the question of giving financial help to such organizations, if they are set up.

It is seen from the Secretary's report that both the English and the Kannada editions of the journal of the Union are not being brought out regularly and that the Kannada edition particularly is very much behind hand. It is also observed that the circulation of both is rather poor and that their publication involves a heavy financial strain on the Union, so much so, that the Secretary considers it is not the duty of the Union to publish the journals and makes an appeal not only for more members and subscribers but also for

substantial State aid if the publication of the journal is to be placed on a satisfactory footing. From what I have seen of the journal, I have a high opinion of its efficiency and usefulness and I think it will be a great pity if it were allowed to languish for want of funds. I trust, therefore, that the Secretary's appeal to you will meet with a ready and willing response. With regard to the appeal for State aid, I may assure you that I shall be glad to give my full support to any reasonable application that you may make for Government help in the publication of the journal.

I am afraid, gentlemen, I have already tried your patience by taking up a good deal of your time and as you have a long, interesting and varied programme of work before you, which you must be impatient to take up, I shall not detain you any longer but conclude with wishing you godspeed in your deliberations at this session and every success in the work of the Union during the coming year.

Distribution of New Races of Silk-worms.*

BY

H. S. Govinda Rao, B.A.,

Department of Sericulture, Mysore State.

At the last meeting of the Agricultural and Experimental Union, I said that experiments were being conducted at the Channapatna Farm to produce silk-worms which combine all the good qualities of the Mysore Race as well as of the foreign races. I also gave certain figures to indicate the advantages gained by rearing the F_1 (Mysore x Foreign) races instead of by rearing the pure races only. In this paper I am giving a brief report of the work done during the year regarding the distribution of the eggs of the new races to sericulturists. Mr. Yonemura fixed about 12 races which have almost all the good qualities of the Mysore and of the foreign races. The eggs of these races hatch without any treatment within 10 days after they are laid, the worms take less time than pure Mysore ones from hatching to finishing and yield more silk. Of the 12 races

* Speech at the Seventh Annual Meeting of the Union on the 10th November 1924.

fixed by Mr. Yonemura, 6 races produce cocoons of the same colour as Mysore cocoons while 5 races produce white cocoons. Last year, and even when Mr. Yonemura was here, a trial was made in the distribution of these races to the ryots. The races which produce white cocoons were given to the ryots and they got fairly good crops, but there was no demand for cocoons as the local reelers refused to purchase the cocoons or were willing to purchase the cocoons at a lower rate than the pure Mysore cocoons though the white cocoons were superior to the Mysore ones. Besides, the ryots felt some difficulty in rearing as they could not easily make out the worms going to moult and the ripe worms. They showed an inclination to prefer the Mysore race to the superior white cocoon producing race. It was quite necessary to remove this difficulty and see that at the same time the ryot got the benefit of the new and improved races. This object was achieved by the distribution to the ryots of the F_1 (pure Mysore x Fixed) races instead of the fixed races only. By taking the Mysore mother-moth and coupling it with the Fixed race male moth of either white cocoon producing race or coloured cocoon producing race and rearing the progeny for one generation only, good cocoon of the same colour as Mysore cocoons, but superior to them, were obtained. Experiments were conducted in this line and the following are some of the points in which the F_1 claim a definite superiority to the parent Mysore races :—

1. The worms are healthier and stronger than either of the parents.

2. The period from hatching to mounting is shorter than that taken by either of the parents, and certainly far shorter than the pure Mysore.

3. The growth of the worms is even.

4. The worms resist disease better than the parents.

5. The worms are active and vigorous and eat the leaves eagerly and thus the wastage of leaves is less.

6. As the time taken from start to finish is much shorter than is the case for Mysore worms the loss due to contaminative infection is very much less as the worms ripen before the disease develops fully.

After ascertaining the above points definitely, the distribution of these F layings was started in July this year. The sericulturists

as usual were rather doubtful of these worms : when we had made arrangements to distribute about 10.000 layings of these in August. we got indents for only about 2.000 layings and distributed about 1,700 layings. July and August are the worst months of the year so far as silk-worms are concerned. The rainy weather combined with the high temperature is fatal to silk-worms. Even those ryots who have been rearing the Mysore worms for years together and who know something about the rearing lose their crops due to flacherie, etc., in these months with the best disease-free seed of Mysore race. The F_1 worms proved very good in this season. The ryots were very much satisfied with the behaviour of these worms in these troublesome months. Of course due to ignorance. one or two of them got unsatisfactory results in the same village but they attribute the failure to their own fault. Printed copies of instructions regarding the rearing of these worms were distributed to the rearers whenever they took these F_1 layings. The ryots gradually realized the advantage of rearing these worms and indents for these layings have been increasing. The following statement gives an idea of the growth of demand :—

	Demand	Supply
July 1924	1,900 layings	1,055 layings
August	2,500 ,,	1,783 ,,
September	2,050 ,,	1,400 ,,
October	10,300 ,,	9,163 ,,
November .. .. (Up to 9th)	5.000 ,,	

A few points have to be borne in mind in rearing the F_1 races.

1. Since the worms are active and eat vigorously, they should be fed properly.

2. Since the worms begin to form cocoons about the 6th day after the fourth moult, they should be given tender leaves for only one day after the fourth moult and mature leaves from the second day onwards. Though this fact has been repeatedly impressed upon the people, they are averse to waste the tender shoots and by trying to utilize them for feeding the 5th age worms for two or three days, they get a reduced yield of cocoons.

3. As the cocoons produced are of the same colour as the Mysore cocoons and are much superior, the rearers are always tempted to

sell them for seed or keep them for seed themselves. By doing this they will cause a great loss to the purchaser as well as to themselves as the worms in the second generation may produce cocoons of two colours and may not develop uniformly. As such, the cocoons should not be kept for seed but must be used for reeling only.

4. The rearers have some conviction as to the number of feedings to be given to the worms. They generally give 7 feedings a day to young and grown-up worms irrespective of the climatic conditions. They ought to feed the young worms more often than the grown-up worms.

The following is a comparative statement giving details regarding the yield obtained from one hundred layings of pure Mysore and F_1 worms :—

	No. of days taken	No. of days after IV moult	Quantity of cocoons in lbs.
July and August.—			
Pure Mysore ..	30—15	8—10½	25
Mys. x Mys. Fixed F_1	28—12	7	50
August and September.—			
Pure Mysore ..	30—4	9 days 3 hrs.	23
Mys. x Mys. Fixed F_1	28—12	7 days 3 hrs.	62
September and October.—			
Pure Mysore ..	30—14	9 days 18 hrs.	30½
Mys. x Mys. Fixed F_1	28—0	7 days 10 hrs.	40
October and November.—			
Pure Mysore ..	31—0	9 days	36
Mys. x Mys. Fixed ..	26—0	6 days	55

Some of the rearers have got record crops with F_1 worms but rearer Manni Sab of Bidadi got 135 lbs. of cocoons out of 200 layings. The Convent of the Good Shepherd, Bangalore, got 62 lbs. of cocoons out of 100 layings as also a rearer by name Sidda at Malurpatna. The cocoons were removed from the " chandrike " on the 4th day after mounting and weighed. The usual practice in Channapatna side is to sell away the cocoons the second day after mounting even before the worms have completely built the cocoon.

It is clear that the rearer gets a larger yield, quicker return and more money by rearing the F_1 worms as the cocoons yield more silk. The latest returns from the Government Filature at Mysore are as follows :—

	Number of hours worked—8.	Rendita
From F_1 cocoons	.. 450 grams of silk	14.5
Mysore cocoons	.. 290 grams of silk	16.0

Thus as the reeler can produce $1\frac{1}{2}$ times the silk in a day of 8 hours with F_1 cocoons and as only about 14 lbs. of F_1 cocoons give 1 lb. of silk as against 16 lbs. to a lb. in the case of pure Mysore the filature man will certainly pay higher prices for these cocoons. The rearer is benefited both with reference to the quality of cocoons produced per unit as also with reference to the money he gets.

The local reelers feel some difficulty with regard to the reeling of these cocoons. One reeler got a lb. of silk out of 18 lbs. of cocoons and he produced altogether 10 lbs. of silk and 12 lbs. of waste out of 185 lbs. of cocoons. This is because he did not cook the cocoons properly and treated them in the same way as he treated the Mysore cocoons. We were quite willing to purchase the cocoons at a price 8% higher than for the Mysore cocoons, but he preferred reeling the thing himself. Arrangements have been made to instruct the reelers as to how they should treat these cocoons to get the best yield from these F_1 cocoons.

The demand for these F_1 layings is increasing and the preparation of these layings entails much labour and expense and equipment. It is also necessary to set apart a few trained people to inspect the rearings of the ryots and give them timely instructions. Any amount of literature will be of no avail as the majority of the rearers are illiterate. Timely and personal advice is quite necessary. The members of the Union should take up the work of instruction and rearing of the pure races for seed.

Silk Industry at Mariapura Farm, Kankanhalli Taluk.*

BY

P. S. Fernandez,

Catholic Priest, Mariakoppam Post, Kankanhalli Taluk.

I desire to present to the Union a summary of the establishment and progress of Sericulture at my orphanage colony, Mariapuram. Half a century ago, as local tradition runs, sericulture was at its zenith in the old Thattkuppe and the surrounding places. But owing to famine and pestilence the old village and the best sericulturists of the surrounding places disappeared, hence the industry too died with them. Ever since some individuals tried mulberry cultivation on a small scale but their success was only for a short time. They had one or two successful crops, then the failure of crops discouraged them so much that they pulled out all the plants and put in ragi or other crops instead. After my coming here, with the encouragement given by some experienced men and by the instructions given by the Sericultural Department I began with 4 acres of mulberry plantation in July 1923. (And this year I have extended the garden by one acre.) Unfortunately that year there was scarcely any rain in this locality. I could get only 2 crops. All my initial expenses amounted to Rs. 450 and the income of two crops was Rs. 600. As the tank water went below the sluice in last December, till the setting in of the monsoon I could preserve the garden from drying with baled water at a great cost included in the expenditure for the year. This year the garden was pruned in July. Three carts of cuttings were given free of cost to the local ryots who were encouraged by my success. During this year as we had heavy showers of rain and the tanks being full several others are willing to take up sericulture.

As regards silk rearing to facilitate my work I had one of my villagers trained in the Mysore Silk Farm at my own cost. When I began rearing, the Department helped me with one operative until I had confidence in the newly trained hand. The rearing was conducted well and I had every success. At present I have 1,000 layings being reared. The first batch is already moulted and the rest will be over by the 20th instant.

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* Paper read at the Seventh Annual Meeting.

The main factor in success lies in my having obtained disease-free layings from the Department. The failure of many ryots may be attributed to the diseased seed-cocoons. The layings got from the Department apart from being reliable are a source of blessing to the rearer as they save the trouble of searching for seed-cocoons and paying a high value.

Of all the rearings the easiest and the most economic was the rearing of new races fixed by the Department. These races take about 26 days for rearing whereas the Mysore race takes about 30 days, there being a difference of four days. During the 5th moult a very large supply of leaves is required. At the rate of three pounds of leaves for a tray for each feeding, for four days about 96 pounds of leaves are saved by the new races. There is a saving of top leaves too. While I reared 125 layings of the fixed white race successfully, with the same batch of layings which were supplied to others, many of them had a failure. I got eighty pounds of cocoons. These new races are to be given only one day's feeding with top leaves which is not the same with the Mysore race which requires three days' feeding.

Although the silk industry is a cottage one it is possible to conduct it on a large scale and derive profit. But personal interest is the first factor for success, the second is to have the necessary staff.

Many ryots of the surrounding villages and some from the Anekal Taluk came to me and expressed their desire of taking up sericulture, but they are ignorant of rearing the worms. Many of these did not know that there were demonstration farms established by the Government and that necessary instructions were given to the needy.

I should like to suggest that Government open a demonstration farm in taluks where they are not yet established and reserve yearly two scholarships in each taluk to help the ryots who desire to be trained as operatives. But these will have to work locally and teach others, without expecting any Government employment. This will not only help the ryots to have success in their industrial work but also develop sericulture all over the State so that in the long run the villages will improve and sericulture will thrive as well as in Japan.

I have brought here* a few sample of cocoons from my own rearing, the best of which are the produce of the new races.

* The samples were shown round at the Meeting.

I would also suggest that a Sericultural Conference should be held as a part of the Union work in one of the sericultural centres so that the difficulties of the sericulturists may be fully discussed and also that sericulturists may familiarize themselves with Experimental Work which is being conducted.

The Manure Problem of the Mysore State.*

BY

N. Krishna Iyengar,

Inamdar, Uragahally Estate.

I

As I have been asked to open the discussion I shall not take up your valuable time by making a long speech but shall content myself by offering a few preliminary remarks as regards the importance of the subject and mentioning a few points which I think may be brought to your notice.

I am sure you all know that manure is one of the important things a farmer needs to produce heavy crops. By its judicious and adequate use the fertility of a continually cropped land can fairly be maintained.

Only a short time back the Mysore farmer's knowledge of manure did not extend beyond the collected droppings of animals, green manure, tank silt, town refuse, wood ashes, etc.

Since then the population has increased, facilities for transport have improved and the markets widened, the general knowledge of the farmer has improved and his outlook widened, his standard of living has risen ; consequently a large extent of land has come under the plough and cultivation is still extending Government having given facilities for expansion by releasing Amrit Mahal kavals, date groves and gomal lands. Increase of cultivation has restricted stock on the farm, thereby reducing the quantity of manure available. Scarcity of fuel for domestic purposes further reduces this quantity. The growing of crops which consume large quantities of manure such as sugarcane, mulberry, potatoes, coffee, etc., is on the increase.

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* Speech at the Seventh Annual Meeting.

The Department of Agriculture anticipating this shortage of manure has been for some time past conducting experiments with a view to supplement the available manure by oil-cakes and chemical manures.

The results so far obtained have been encouraging and the Mysore farmer under the readily available help and guidance of the Department of Agriculture has not been slow to benefit by the use of commercial fertilizers.

Now another difficulty has arisen. The price of oil-cake which was comparatively low only a few years ago has risen considerably and the major portion produced in the State is shipped to foreign countries. At the present market price of oil-cake, nitrogen in sulphate of ammonia is cheaper than in oil-cake.

It is advantageous to buy chemical manures in large lots from importers. The requirements of the ordinary farmer not being large, it would be convenient if Government would undertake to stock these manures and retail it to the farmers until such time as the co-operative societies would be able to do the work.

However cheap these chemical manures might be it is not possible to go on growing heavy crops without the application of farmyard manure to keep up the bacterial activity in the soil. Under these conditions to keep extensive areas under heavy crop I would suggest giving a light dose of cattle manure just to maintain the bacterial activity and to supplement the requirements of the crop by chemical manures.

The Manure Problem of the Mysore State.*

BY

B. Narasimha Iyengar, B.A., Ph.D.,

Agricultural Chemist in Mysore.

II

This problem is very intimately connected with the increase of agricultural production in the State. An adequate supply of proper manures must go hand in hand with the introduction of improved implements and new high yielding strains of seed ; otherwise owing to intensive feeding of the higher yielding varieties of seed an impoverishment of the soil will take place and the yields go down very soon.

It is not very easy to get maximum yields from our fields by the application of farmyard manure alone. In the first place, the large quantity of manure needed is not available, and secondly, by the application of it alone it is not possible to cater to the individual and special needs of every kind of crop. Hence recourse must be had to the application of artificial manures.

Of the manures that we may profitably apply, the various kinds of oil-cakes are the only ones produced in the country. But the use of oil-cakes alone does not supply a crop like sugarcane with the necessary amount of nitrogen during the most vigorous stage of its growth and at a reasonable cost. Hence recourse must be had to the use of such manures as sulphate of ammonia.

Of phosphatic manures, superphosphate is the one which has been found to be very useful in increasing crop-yields.

These two manures have only been recently introduced into the agricultural practice of the State, and there is a very great scope for their extended use and consequent increase of agricultural production in this country.

In this connection, a few general principles touched upon by Professor Lemmermann of Berlin in an article on " The Importance of the Supply of Artificial Manures to Germany with Special Reference to Phosphates" published in Germany in the early part of this year may be of interest and use to us as well.

We all know that Germany had a very intensive system of agriculture before the Great War. This development took place gradually

* Speech at the Seventh Annual Meeting.

between 1890 and 1913. During that period, the yield of corn (Rye) per acre increased by 61% and that of potatoes by 56%. During the same period, the use of artificial manures also increased enormously. Their application rose from 32 million cwts. to 214 million cwts., *i.e.*, an increase by nearly 600%.

The bulk of the artificial manures was imported from abroad and the supply was naturally cut off soon after War broke out in 1914. As a consequence of this and other factors, the crop yields during 1913—19 went down considerably. The acre-yields of corn decreased by 21% and of potatoes by 31%.

We all know that increase in crop-yields can be brought about not only by manuring, but also by the introduction of better seed and improved implements of tillage. Of the increase that can be brought about by a combination of all these three factors, Lemmermann says that 50% is due to manure, 30% to higher yielding varieties of seed and 20% to cultural and other operations. Of all the factors under our control for the increase of agricultural production, that of manuring is said to be the most important.

Climate also plays a very important part in limiting the increase of agricultural production. For the continental climate of Europe, A. Mayer places the maximum limit of corn at about 4000 lbs. of grain per acre and P. Wagner, with his 50 years' experience of pot and field experiments places the average for Germany alone at 2500 lbs. per acre.

I am not yet in a position to tell you exactly what the maximum average yield of grain per acre can be in our climate. From small-scale experiments on ragi, I am inclined to believe that the maximum that can be obtained under ideal conditions in this climate seems to be about 7 or 8 thousand lbs. of grain or 35 to 40 pallas per acre. This is only the ideal to be aimed at and the actual yield will be very much less under field conditions. The average yield of ragi per acre for the whole State is at present only about 2 pallas or 400 lbs. and we shall have done great deal if we can double that average in the near future.

According to the experience of German Agricultural Chemists there are certain conditions affecting the utilization of nitrogenous and phosphatic manures, when they are applied together. Only 60% of the nitrogen in the manure applied and 10% of the soluble

phosphoric acid seem to be used up by a crop, and the application of nitrogen and phosphoric acid in the ratio of 1 : 3 has been found to be the most favourable for plant growth and this seems to have also been the ratio in which nitrogenous and phosphatic manures were being imported into Germany before the War.

Since the close of the War, Germany seems to be getting more and more independent of foreign sources with regard to the supply of nitrogenous manures. But she is still mostly dependent on foreign supplies for phosphates and research in the direction of making herself independent of such foreign supplies has brought to light some interesting facts. The German Scientists found that 40% of their soils still respond clearly to phosphatic manures, 20% in an indifferent manner and the remaining 40% not at all. In trying to find out the reason for this want of response, it was found out that soils rich in silicic acid did not respond to phosphates. Further research has shown that silica is partly capable of displacing phosphoric acid in plant nutrition. To be effective, the silica is to be given in a finely divided state.

The fact that soils rich in silica did not adequately respond to phosphatic manuring had previously been observed at Rothamsted in England, but the reason then given for it that silica liberated phosphoric acid from the soil is not found to be satisfactory now.

Even with us, while there are very few soils which do not respond to nitrogenous manures, there seem to be a few types which do not appear to respond to phosphates. It is with reference to manurial requirements of such soils that the above referred to researches in Germany may give a clue to us.

Spraying against Black Rot of Coffee.*

BY

T. Narasinga Rao,

Coffee Planter, Chikmagalur.

As promised by me during the last meeting of our Union I continued the experiments against the Black Rot of Coffee this year also. Prior to the commencement of the spraying, Dr. Leslie C. Coleman and Mr. N. Rama Rao visited my estate, in the month of May, and were satisfied with the results achieved. A noteworthy fact is that though there was phenomenal rainfall during the year 1923, we could see traces of the mixture still adhering to the under surfaces of some of the leaves in the sprayed portion.

During this year, spraying was begun by about the middle of June. As usual, the Agricultural Department was kind enough to spare me the services of Mr. S. V. Venkatarayan, Assistant Mycologist. The necessary chemicals and sprayers were supplied by the Department free of cost and the planter had to supply only the labour necessary to carry on the spraying operations.

This year, I have sprayed a larger area than I did last year. Two blocks of last year's experiment were sprayed with two per cent Bordeaux mixture as before. They comprised about 300 plants. It was suggested to me by Dr. Coleman during his visit, that it would be interesting to watch the results of spraying with a weaker solution. Accordingly, the other two blocks of last year were sprayed with 1% mixture. These also comprised 300 plants. In both the cases the adhesive used was resin. The check blocks introduced last year remained unsprayed as before.

In another portion of the estate where the Rot used to be severe, about 350 plants were sprayed with the 1% mixture and resin as adhesive. Another about 320 plants were sprayed with the same 1% mixture but casein was used as adhesive in the place of resin.

Now as regards the results in spite of the fact that we had unprecedented rainfall in the month of July, all the sprayed portions, irrespective of whether they were sprayed with the stronger or weaker mixtures or whether resin or casein was used as adhesive, were uniformly free from the disease, while the check blocks suffered badly.

* From Mr. Narasinga Rao's first report, *vide* Vol. IV, No. 4, of this Journal.

The sprayed blocks have a heavy crop this year and also good wood for next year.

The final result* of these experiments can only be known after the crop is picked. It is only when the crop of the sprayed and unsprayed portions are picked and separately measured that we can correctly estimate the extent of loss that we annually suffer from this disease. I intend picking the crop of the sprayed and check blocks separately, and shall intimate the result to the Secretary of the Union by about the end of January next.

After last year's experiments, I was able to induce some of the neighbouring planters to get small portions of their estates sprayed. The disease had already broken out when we began spraying on the estates of the following gentlemen, namely, Messrs. C. Srinivasa Rao, C. Vasudeva Rao, M. Nagappa Chetty, M. Krishna Chetty, K. Hanumantha Rao, and Sidda Veerayya of Bisagni Mutt. It is gratifying to note that one Ranga, a Panchama servant, who had assisted in spraying operations last year, and had closely watched its effects, got about 150 young plants sprayed on his own estate.

On my reporting to Dr. Coleman that some of the planters mentioned above told me that the dropping of crop was heavier in the sprayed than in the unsprayed portion, he was kind enough to send Dr. M. K. Venkata Rao, Mycologist, to inspect all the sprayed estates. We visited them all in the month of September while the disease was still prevalent. We could see that in all the estates there was a marked improvement in the condition of the crop of sprayed over unsprayed plants. Except in the case of one estate the planters themselves were fully convinced that spraying had done immense good to the plants.

I had noticed that in the month of July, when the rains were abnormally heavy, there was a general dropping of the crop both in the sprayed as well as the unsprayed portions. The dropping of the crop during this and the succeeding months, is a general feature of all coffee estates, as evidenced by the experience of several planters, and is due to causes not yet investigated. While the dropping of the berries in the sprayed portion ceased as the monsoon advanced, it continued in the unsprayed portion till the end of September.

* Mr. Narasinga Rao has since reported results which will be published in our next issue.

The cost of spraying an acre of coffee with the different kinds of* mixture, is shown in the following table. It varies according as the plants are pruned or not :—

Cost of Spraying One Acre, 1,200 Coffee plants.

Condition of the plants.	Two per cent Mixture. With resin.	Two per cent Mixture. With casein.	One per cent Mixture. With resin.	One per cent Mixture. With casein.
Well pruned	Rs. 18 8 0	Rs. 16 12 0	Rs. 8 4 0	Rs. 6 15 0
Lightly pruned	„ 23 2 0	„ 20 15 0	„ 11 0 0	„ 9 4 0

The number of coolies required for spraying an acre of 1,200 plants comes to 10. Their charges at the rate of annas 6 a cooly would come to Rs. 3-12-0.

The one per cent mixture with casein is quite as good as any of the others. In addition it has the benefit of cheapness to recommend it. It is much easier to make than the mixture with resin as adhesive. because in the latter case the boiling of resin takes full three quarters of an hour with a man constantly at it. whereas the casein adhesive is prepared in a few minutes, and that without any boiling. The cost then varies from Rs. 10-11-0 to Rs. 13 an acre.

Further Experiences with the Rhinoceros Beetle. †

BY

H. Sreenivasa Rao,

Retired Deputy Conservator of Forests, Hongenahally. Malur.

Sand and Salt.—These beetles cannot do much damage to grown-up plants in a single day. They prove dangerous if they are allowed to keep boring in for several days as they may then destroy the growing tissues. They also prove dangerous when a new insect enters an old hole which is kept open. In such cases the new comer works down from where its predecessor had left and reaches the growing point soon. With a view to prevent a new insect from entering an old hole all such holes were filled with a mixture of sand and common salt which appeared to be a success for some days. But instances have been noted, though their number is not very numerous, where

* Details regarding the preparation of these mixtures will be given in our next issue along with Mr. Narasinga Rao's report of final results.

† Report sent in for the Seventh Annual Meeting.

the newly come beetle had scooped out the sand and salt with which the hole had been filled for effecting an entry into it.

Marothi Cake (*Hydnocarpus Whittiani*).—Experiments had been conducted with the marothi cake also. In this experiment the lower half of the hole had been filled with sand and salt and the upper half with powdered marothi cake. For about a fortnight or two the beetles were not noticed to have entered the holes so filled but subsequently they were found to have scooped out the cake and sand for entering the old boring. Therefore it is to be concluded that neither sand and salt nor marothi cake are reliable protections against beetles but they are useful to a large extent only in preventing the Rhinoceros and other kind of beetles from effecting an unchecked entry into holes once bored.

Spraying with Bordeaux Solution.—Spraying with Bordeaux solution has been recently taken up as an experiment. I believe a hundred trees or more must have been sprayed by now as work was going on when I left. The results will be made known in the near future.

NOTES AND COMMETNS.

Two Holstein Friesian Cows at Rayankere.

Some interest to the readers of this Journal should be attached to the recent importation of two Holstein Friesian cows from America to the Rayankere (Palace) Dairy Farm which is probably the first importation of pure-bred cows of this breed ever made into India. Both of the animals are under three years old, and are well grown promising-looking cattle. The large frame and great growth of bone are two of the features that strike all visitors who see these animals and are indeed worthy of remark in comparison to the country-bred animals on the Farm. The breeding of both animals is good and perhaps a few details in this connection will be of interest.

The older of the two cows, by name, Matador Echo Pride, was born on February 7th, 1922. Her great grand dam on the mother's side is the famous record milk-yielding cow, May Echo Sylvia, while her mother (dam) made a yield of 22.335 lbs. of milk and 912 lbs. of butter in a year as a three year old. The cow is a grand-daughter of the bull Avon Pontiac Echo which is now proving to be one of the greatest getters of heavy milking stock in America. At the age of 2 years and one day Matador Echo Pride qualified for Advanced Registry with a yield of 333 lbs. of milk and 14.77 lbs. of butter fat in seven days. She is now dry but due to calve in about a month's time and with ordinary luck should make a showing at the milk pail which will be sensational compared to anything done in the State in this direction up to the present.

The second heifer, by name, Avon Pontiac Countess, was born on April 25th, 1922, and is due to drop her first calf in the middle of March. She is a fine strong specimen of her breed, with an even straight top and a deep and wide chest so necessary to a strong constitution. She is in calf to a young bull "Carnation Prospector" which has shown himself to be very prepotent and is of undoubted good breeding. The calf itself will be of great value, whatever sex it may be, while the cow should prove herself to be a good milker. She is sired by the same Avon Pontiac Echo which figures in the pedigree

of the first cow described above. It is almost impossible to buy the daughters of this bull now, on account of their good performance, and we can consider ourselves lucky in having obtained one. The dam of Countess is a cow for which Rs. 4,500 was paid by her present owners, and has a record of 558 lbs. of milk in 7 days, and 22,076 lbs. of milk, with 963 lbs. butter fat in a year.

These two cows are well worth inspection by those interested in the development of dairying and cattle breeding, and in fact even by those with only a casual interest in animal husbandry. A visit during the middle or end of March should find one or both of them newly calved, at which time they should be at their best.

In this connection it may be remarked that very few of the members of the Agricultural and Experimental Union have yet made a visit to the Rayankere Dairy Farm. This is a matter of great disappointment to the writer, who has always hoped that such an important subject as dairying in the State would awaken a wider interest than appears to exist at present. There are numerous visitors to the farm but a very large percentage of these are from outside the State. The public of Mysore owe it to themselves to be informed with regard to developments within the State, and members of the Union are specially invited to make a visit to the Rayankere farm with this end in view.

[W. D.]

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Agricultural Education in the United States.

The New Zealand Journal of Agriculture of September 1924 contains an article on Agricultural Education in the United States, by James Begg. In giving an account of his visits to the Washington and Oregon State Colleges he says :—

"The students of agriculture do not learn the ordinary work of farming at these colleges. Their time is regarded as much too valuable to be spent in learning how to plough and sow, and handle horses, but they spend a portion of their time on the farm, seeing in practice the principles they have learned in the class-room, being taught how to conduct experiments with exactness, and learning how to pursue investigation to a final conclusion. Judging of live-stock is given an important place as cultivating close observation, training in exact judgment and reasoning, and also ability to state clearly and concisely in writing the reasons for the conclusions arrived at. It must not

be inferred. however. that the practical work of farming is ignored. Students are required to get this practical knowledge either before entering the college or during the vacations. The agricultural school, as we know it at Lincoln and Ruakura. is conducted on different lines to anything I saw in America. The practical work of farming is not taught at the colleges, and I did not hear of any institution where it was taught ; it is not considered necessary institutionally."

Such being the case in America. and so far as we know in Germany and England as well. we fail to see any special reason why our young men at agricultural colleges in this country should be made to do a lot of manual labour in the form of "Practical Agriculture". We are of opinion that some reform is urgently necessary in this direction. The training in practical agriculture might conveniently be given to the students at some of the demonstration farms— which ought to be self-supporting—after their theoretical training in the college is over. [B.N.I.]

* * * * *

Our Annual Meeting.

The seventh annual meeting of the Union was held on 10th November, 1924 and succeeding days, and it was opened by Mr. K. R. Srinivasa Iyengar, Member of Council.

In his welcome speech Dr. Leslie C. Coleman. the President of the Union, dwelt upon the fodder distress of the previous year, the measures adopted to relieve that distress. the success of these measures and the lessons learnt thereby for future guidance. Dilating upon the statistics of cattle he drew attention to the fact of trying to maintain more cattle than the fodder supply warranted and on the inefficiency of the existing draught as well as milch cattle. The other points referred to by him in his speech relate to the new Mysore plough, the question of manures and their supplies. and the development of Sericulture.

From his long experience of agricultural conditions as a Revenue Officer, Mr. K. R. Srinivasa Iyengar suggested a few lines of work which might usefully be tackled by our members.

The programme was rather a crowded one as usual and consequently much time could not be devoted to discuss important questions such as relating to the manurial problems of the country. A very

interesting paper on Agricultural Implements by Mr. A. K. Yegnanarayana Iyer presented to the meeting, could not even be read, and for want of space in this number of the Journal we have reluctantly postponed the publication of it to the next number.

The last day of the meeting was a Field Day and spent at Hebbal as usual. More than 200 members were present and evinced great interest in the field experiments going on there. A small cattle show for the progeny of the breeding bull of the Farm was a new item added to the programme this year.

A small seed drill designed by Mr. K. M. Gururaja Rao, Manager, Babbur Farm, was also exhibited in working order. In addition, demonstrations of the working of the Mysore plough made in England as well as at the Bhadravati Iron Works were given. [B. N. I.]

* * * *

A Sericultural Conference.

A conference of sericulturists of the Bangalore District was held for the first time on the Central Silk Farm at Channapatna on 21st December, 1924 at which Dr. Leslie C. Coleman, the Director of Agriculture, presided. More than 300 delegates were present. In the farm, demonstrations were given on improved methods of rearing both the indigenous as well as cross-bred varieties. A reeling competition was held among reelers by the local method of reeling, and a demonstration was given of reeling by a new domestic unit designed by the Department of Sericulture. In the mulberry garden members and visitors were taken round to see the crop under various manures. After dinner the conference met at 2 P.M., to discuss subjects connected with sericulture and its improvement and the proceedings came to a close at about 7 P.M. [B. N. I.]

SELECTIONS.

The Stifling of Silkworm Cocoons.

In the "*Bulletin de la Societe Encouragement pourl' Industric Nationale*" for June, 1924, M. G. Bertrand describes how extremely sensitive the chrysalides of the silkworm are to the vapour of chloropicrin. The shell in which the chrysalides are naturally enclosed does not protect them appreciably from attack by the vapour, which ensures a complete and rapid stifling of the cocoon. One gram of this agent per 1000 gm. of cocoons acting for one hour at 20° C. will effect the desired result, even if double cocoons are present. On exposure to air, the cocoons lose practically all odour of chloropicrin and dry readily. The stifling produced in this way, which is equal and sometimes even superior to that secured in the usual "dry and humid heat" industrial process, does not affect the silky envelope, the colour and other original qualities of the cocoons being retained. Neither do the spinning qualities decline. The tenacity and elasticity of the fibres obtained by the new and old processes are found to be the same. The author emphasizes the fact that the new method is, both from the academical and industrial points of view, economical and requires less supervision, since the margin of safety, without fear of damage to the silk, is very considerable. It is claimed that the chloropicrin process is convenient and certain, has no objectionable action on the silk, and requires no complicated or costly installation.—*Nature*. (*Vol.* 114, *No.* 2865, *page* 481.)

Present-Day Problems in Crop Production.

BY

Sir E. John Russell, F.R.S.

The visits of the British Association to Canada have hitherto very appropriately coincided with definite stages in the progress of agricultural science and practice. It was at the Montreal Meeting of 1884 that Lawes and Gilbert presented their well-known paper on the sources of the fertility of Manitoba soils which ended the first period

of the development of agricultural science. This period had lasted eighty years ; it had been ushered in with the precise and scientific work of de Saussure published in 1804 ; its outstanding features had been the foundation of agricultural science by Boussingault in 1834, its enrichment by Liebig's brilliant essay of 1840, and its systematic development by Lawes and Gilbert at Rothamsted from 1843 onwards. The whole purpose of the scientific workers of the period was to feed the plant ; in Gilbert's own words the message of the crops on the Rothamsted plots was, "If you won't feed us we won't grow". The success of the new science was remarkable ; its great triumph was the discovery of artificial fertilizers and their introduction into farming practice, and the workers had the great joy of seeing the crop yields rise considerably as the direct and recognized result of their labours. The problems were largely chemical, and agricultural science was regarded as simply a branch of chemistry. Gilbert's paper in 1884 was read before the Chemical Section, and it presented soil fertility as essentially chemical ; a fertile soil, he argued, is one containing much plant food, especially nitrogen ; it is one "which has accumulated within it the residues of ages of natural vegetation, and it becomes infertile as this residue is exhausted". At the time of the Toronto Meeting in 1896 a new period had begun, quietly and unnoticed, but growth was so rapid that at the Winnipeg Meeting in 1909 the subject had grown right away from chemistry ; it had become a definite sub-section, and its importance was so widely recognized that a recommendation was passed asking the Council to set it up as a full section, which was subsequently done.

In this second period the purpose was not to feed the crop but to study it ; to discover what factors are concerned in the growth of crops and how they operate. This period, which may be called the period of free exploitation, since the workers were not usually tied down to any particular technical problem, began almost simultaneously in the United States, in France, and in Germany. As soon as agricultural science was studied in the United States it became evident that the cultivation of the soil was at least as important as the feeding of the crop. This fact had, of course, been fully recognized in the English experiments, but the English farmer was so skilled in cultivation that he could be taught but little by science. The early American work as developed by Kedzie at Michigan, King of

Wisconsin, Hilgard and Whitney, was largely physical, and it greatly widened the outlook of agricultural investigators, opening the way to the extensive physical and physico-chemical studies which have now become so characteristic a feature of American work. The French investigators, particularly Schloesing, Muntz, Berthelot, and Déhérain, and the brilliant Russian, Winogradsky, then in Paris revealed a new world of soil micro-organisms, the wonder and mystery of which appealed to the imagination of the younger workers in a way that none of the older utilitarian work had done. The Germans methodically explored the fields thus opened up; Hellriegel and Wollny accumulated a mass of data as to plant growth and soil changes which still remains of value to the student. These pioneers were succeeded by a host of followers whom it would be impossible to enumerate at length, and from whom it would be invidious to select a few. Moreover, the chemists and physicists of the old school were no longer left in sole possession; van Bemmelen introduced the conception of colloids, and at a later date Mitscherlich, Baule, and others developed the idea of mathematical expressions for the data of agricultural science. Sachs and his pupils in Germany, Déhérain, Maquenne and Demoussy in France, joined up the new science of plant physiology with agricultural science. The plant breeder also came in; Gregor Mendel's work, after lying hidden for forty years, was revealed to the world by Bateson and was at once turned to agricultural use in England by one of Marshall Ward's pupils, R. H. Biffen; and in the United States by Webber and others. The selection method was developed to a high pitch of perfection in Canada by William Saunders, a revered leader in our science, whose dignified presence and kindly words of greeting remain as a vivid recollection of our visit fifteen years ago. His mantle has fallen on his son Charles, who has continued and developed the work.

The result of all this effort has been the accumulation of an enormous mass of information covering a very large part of the field with which agriculture has to deal. It has been essentially a pioneer period, with all the advantages of keen individual interest, controversy, sometimes even of excitement; but also with the disadvantages of a certain lack of perspective, failure to follow up important issues and some narrowness of outlook inevitable when a single individual is working alone at a great subject.

Generalizations that have emerged.

But in spite of these drawbacks several important generalizations have emerged. One of the most pregnant in possibilities for the future is the recognition that the plant is a very plastic organization and can be modified to a considerable extent within certain limits. Two methods are adopted: breeding, which may be on observational lines or on the Mendelian method of picking out the desired unit characters from plants in which they occur and assembling them in a new plant; and selection, in which a desirable plant is caused to produce seed from which stocks are multiplied. The scientific problems fall within the province of the science of genetics; the practical significance of the work lies in the fact that it greatly simplifies the agricultural problem by providing plants more or less suitable to the existing natural conditions where otherwise the expert would have the difficult, if not impossible, task of making the conditions suit the available plants. The work has proved extraordinarily fruitful and has given astonishing results even in our own time. It has played no small part in the amazing development of wheat growing in Canada. When the British Association went to Winnipeg in 1909 we were all impressed by the fact that Canada had then passed the 160-million bushel mark in production, but who would have thought that within fourteen years the production would exceed 474 million bushels? Even in England, where wheat has been grown for 2,000 years, and where farmers have a long traditional knowledge of the crop, the new varieties introduced by Biffen have increased the yields and the certainty of yields. The triumphs of Webber and others in the United States, of Nielson Ehle with cereals in Sweden, Jeffreys in standardizing the quality of cotton in Egypt, the Howards in producing wheats for India, to mention only a few, are still fresh in our minds. In the first period in the development of agricultural science the honours in the matter of practical applications lay with the chemists for the artificial manures, but in the present period we must admit that they lie with the plant breeders and selectors who, indeed, are only on the threshold of what they may yet accomplish. And this great practical purpose of finding or producing varieties of crops specially suited to local conditions would be further advanced if the work were done in co-operation with plant physiologists who could precisely define the modifications required. Much saving of time and effort could be

effected if it were possible to set up some international garden where small quantities of the plant breeders' productions could be grown, including those which each one has rejected as being unsuitable to his particular requirements. Many of these unwanted outcasts might prove of value in other conditions.

A second generalization is that the soil is not a fixed, constant thing, but is pulsating with change. It contains a great population of micro-organisms which, among other activities, decompose the dead plant residues, producing nitrates, humic and other substances of great importance in crop production. But the numbers of these organisms fluctuate continually; and the bacteria at least change hourly; the nitrates suffer equally rapid changes in amount. Even the mineral part of the soil is not constant in composition. Modern research work shows that many of the properties determining fertility in soils are due to the soil colloids, and some of the most important are attributable to calcium complexes. These are unstable and are affected by the soil water. If the water is free from salts but contains carbon dioxide, the calcium may be replaced by hydrogen, and an acid soil results; if the water contains sodium chloride the calcium is replaceable by sodium and the resulting complex may readily give rise to an alkali soil. So far as is known, the changes are governed by the ordinary stoichiometric laws, the equilibrium following the usual course expected when a colloid is concerned. But the important fact emerges that any soil not well supplied with calcium contains within itself the possibility of becoming acid and therefore infertile, or alkaline and probably sterile, according to the nature of the soil water soaking through it. The various biological and chemical changes tend to alter the composition of the soil solution. Apparently, however, the colloids have a steadying or "buffering" effect, reducing the degree of acidity caused by the production of acids and absorbing or precipitating various ions that might otherwise cause disturbances.

A third important generalization that has emerged is that the relations of the plant and the soil are not rigidly fixed but are capable of considerable variation, being profoundly influenced by a third factor, the climate. A soil moderately fertile in one set of conditions may be relatively unproductive in another. This happens repeatedly with soils containing much clay or much coarse sand. In Table 1 are given the mechanical analyses of two soils one of which, the Lias

clay from England, is quite unworkable and remains derelict under our conditions of cool temperature and moderate but frequent rainfall, by reason of its high content of clay and fine silt; while the other, which contains even more clay, is capable of carrying good crops of grain and cotton under the hot dry conditions of the Sudan. The Western prairie soil is of similar physical type to that of the English Weald soil, but while the prairie soil under its climatic conditions of warm dry summer and cold dry winter is, and is likely to remain, a fertile wheat producer, the Weald soil, under the wetter conditions of England, is less fertile. In hot dry conditions the clay is no disadvantage and may even be an advantage, but in wet conditions it becomes a serious drawback; indeed, it might be possible to find some mathematical relationship between rainfall and degree of objectionableness in clay.

It appears then if a fertile soil were carried from one country to another its productive power would not necessarily be carried with it. Its fertility is, to a considerable extent, dependent on the fact that it fits in with the climatic factors in producing conditions favourable to good growth of desirable crops.

TABLE 1.

Soils of similar types as regards mechanical analysis, but varying greatly in fertility by reason of climatic differences.

	Rich in finer fractions			Rich in coarser fractions		
	Waste land very difficult of cultivation.	Fertile soil, Millet & Cotton.	Poor farm land difficult to cultivate.	Good prairie soil, Wheat.	Waste land, Norfolk.	Market garden, Anglesey.
	Lias clay Oxfordshire	Sudan	Weald clay, Kent	Brandon	22 in. rain	35 in. rain
Coarse sand 2.0 to 0.2 mm.	0.7	7.6*	1.5	2.5	62.4	93.7
Fine sand, 0.2 to 0.04 mm...	2.0	20.9	11.0	15.4	25.7	2.8
Silt, 0.04 to 0.01 mm...	6.4	12.6	19.6	17.7	0.2	0.5
Fine silt, 0.01 to 0.002 mm.	22.0		26.8	16.1	1.8	0.4
Clay (below 0.002 mm. ...	41.0	55.9	22.1	29.2	0.6	Nil.

* Mainly black nodules of calcium carbonate.

The agricultural investigator is thus confronted with three closely interlocking agencies—the plant, the climate, and the soil—each of which is variable within certain limits, and each playing a large part in the crop production which it is his business to study.

Confronted with a problem of this degree of complexity there are two methods of procedure : the empirical method of field observations and experiments, in which there is no pretence of great refinement and no expectation that the same result will ever be obtained twice, it being sufficient if over an average of numerous trials a result is obtained more often than would be expected from the laws of chance ; and the scientific method, in which the factors are carefully analysed and their effects studied quantitatively : a synthesis is then attempted, and efforts are made to reconstruct the whole chain of processes and results. The scientific method is, of course, the one to which we are naturally attracted. But common truthfulness compels one to admit that up to the present the greatest advances in the actual production of crops have been effected by the empirical method, and not infrequently by men who are really artists rather than men of science, in that they are guided by some intuitive process which they cannot explain, and that they have the vision of the result before they obtain it, which the scientific man commonly has not.

The best hope for the future lies in the combination of the empirical and the scientific methods. This is steadily being accomplished by the recent strong infusion of science into the art of field experimentation, which has much enhanced the value of the field work and the trustworthiness of its results. Modern methods of replication, such as have been worked out at Rothamsted and in the United States by Harris of the Carnegie Trust (Cold Spring Harbour) Kiesselbach in Nebraska, Myers and Love of Cornell and others, constitute a marked improvement in plot technique. And the figures themselves, besides being more accurate, can be made to yield more information than was formerly the case.

Great advances have been made in the methods of analysing the results. The figures are never the same in any two seasons, since the climatic conditions profoundly affect the yields. A few men, like J.H. Gilbert have the faculty of extracting a great deal of information from a vast table of figures, but in the main even the trained

scientific worker can make very little of them. The reason is that he has been brought up to deal with cases where only one factor is varying, while the growth of plants involves the interaction of three variable factors : the plant, the soil, and the climate. It is impossible to apply in the field the ordinary methods of the scientific investigator where single factors alone are studied ; very different methods are needed, adapted to the case where several factors vary simultaneously.

Fortunately for agricultural science, statisticians have in recent years worked out methods of this kind, and these are being modified and developed by R. A. Fisher and Miss Mackenzie for application to the Rothamsted field data. It so happens that this material is very suitable for the purpose since a large number of the field experiments have been repeated every year for seventy or eighty years on the same crop, and on the same piece of land, using the same methods ; the field workers also remain the same for many years, the changes being rare and without break in continuity. Although the statistical investigation is only recently begun, mathematical expression has already been given to the relationship between rainfall and yield of wheat and barley under different fertilizer treatments, and precision has been given to some of the ideas that have hitherto been only general impressions. If on an average of years a farmer is liable to a certain distribution of rainfall, it is becoming possible to advise as to fertilizer treatment which enables the plant to make the best of this rainfall.

Unfortunately, few other Experimental Stations possess such complete masses of data as Rothamsted. Methods are now being devised, however, both by Fisher and by the able English investigator who modestly conceals his identity under the pseudonym "Student", for the study of smaller numbers of data, and it is hoped that these or others equally effective will be applied to the results of field experiments accumulated at various Experimental Stations throughout the world. A massed attack by a competent band of statisticians on the whole of the data of the best Experimental Stations, dealing with yields of crops under different conditions of nutrient supply, temperature, rainfall and other factors that go to make up the aggregate called season, would yield information of extraordinary value.

Investigations of this kind, however, are necessarily slow and they do not themselves afford complete information ; their value lies in

the fact that they reduce a very complex problem to a set of single-factor problems of the type with which the scientific investigator is already familiar. In the meantime, while this work is proceeding, much is being done by observational methods. At Rothamsted the field plots are under continual observation by a group of three workers, a physiologist, an ecologist and an agriculturist, who study such factors as rate or habit of growth, earliness of starting or maturing, degree of resistance to insect or fungus attack; their observations are fully recorded and brought before the chemical, physical and botanical departments at regular and frequent intervals. Certain of the experiments are repeated at other centres on closely similar lines for purposes of comparison. In consequence our old field plots, which have been studied for the past eighty years by Lawes, Gilbert, Warington, and Hall, and might have been supposed to have no further tales to tell, are found to be still yielding results of great interest in agricultural science and practice.

The Results obtained: Alterations in the Plant.

We shall begin with the results obtained by effecting alterations in the plant. Reference has already been made to the changes brought about by the plant breeder, and we need not stop to argue whether the great improvements in crops made in pre-Mendelian days by the Suttons and Findlay in potatoes, by Chevalier in barley, by the Gartons in oats, Vilmorin in sugar beet, and others should be labelled empirical or scientific. There are certain other changes in plants, however, of a purely temporary nature, which have been induced by changes in conditions. It is a common place among farmers that certain soil conditions influence not only the yield but also the quality of crops. The leaf and root are more easily affected than the seed. The case of mangolds has been investigated at Rothamsted; the sugar content of the root, an important factor in determining feeding value, was increased by increasing the supply of potassium to the crop. Middleton at Cockle Park showed that grass increased in feeding quite apart from any increase in quantity—when treated with phosphates. Potatoes are considerably influenced by manuring; increasing the supply of potassium influences the composition of the tubers and also that much more impalpable quality—the cook's estimate of the value of the potato; while we have found at Rothamsted that a high-class cook discriminated between potatoes

fertilized with sulphate of potash and those fertilized with muriate of potash, giving preference to the former.

Grain is more difficult to alter by changes in environmental conditions ; indeed, it appears that the plant tends to produce seed of substantially the same composition whatever its treatment—with the important exception of variation in moisture supply. Mr. Shutt has explored the possibilities of altering the character of the wheat grain by varying the soil conditions, and finds that increases in soil moisture decrease the nitrogen in the grain. Similar results have been obtained in the United States.

On the other hand, in England the reverse seems to hold at any rate for barley. This crop is being fully investigated at the present time under the Research Scheme of the Institute of Brewing, because of its importance in the preparation of what is still Britain's national beverage. Increased moisture supply increases the percentage of nitrogen in the grain, and so also does nitrogen supply, though to a much less extent ; on the other hand, both potassic and phosphatic fertilizers may decrease the precentage of nitrogen, though they do not always do so ; the laws regulating their action are unknown to us.

The practical importance of these problems of regulating the composition of the plant lies in the fact that the farmer can control his fertilizer supply, and also to some extent his moisture supply, so that it lies within his power to effect some change should he wish to do so.

The following are the nitrogen contents and the valuations of barley grown in the same season from the same lot of seed on farms only a few miles apart :—

Effect of Moisture.

	Drier soil.	Moist land.
Nitrogen per cent in grain	1.44	1.80
Valuation per quarter of 448 lbs. ..	52sh. 5d.	41sh. 6d.

Effect of Nutrients.

	No nitrogenous manure.	Nitrogenous manure.
Nitrogen per cent in grain ..	1.379	1.464
Valuation per quarter of 448 lbs. ..	53sh.	52sh.

At present we know but little about the matter, and we are not in a position to advise the farmer as to how he may use these facts

to the full advantage. The complete study of the problem necessitates the co-operation of a plant physiologist.

There is another direction also in which alterations in the plant would be of great value if only we knew with certainty how to bring them about.

In agricultural science one sometimes thinks only of the crop and the factors that affect its growth. But in agricultural practice there is often another partner in the concern a pest or parasite causing disease. The amount of damage done by pests and diseases to agriculture is astounding ; in Britain it is probably at least 10 per cent of the total value of the crops and the loss is probably some £12,000,000 sterling per annum, in some countries it is considerably more. Indeed, the number of insect pests and of harmful fungi and bacteria that skilled entomologists and mycologists have found in our fields might almost lead us to despair of ever raising a single crop, but fortunately the young plant, like the human child, grows up in spite of the vast number of possible deaths. The saving fact seems to be that the pest does harm only when three sets of conditions happen to occur together : the pest must be present in the attacking state ; the plant must be in a sufficiently receptive state ; and the conditions must be favourable to the development of the pest. It is because this favourable conjunction of conditions comes but rarely that crops manage to survive. And this gives us the key to control if only we knew how to use it. Complete control of any of these three conditions would end all plant diseases. Unfortunately, control is never complete even in glasshouse culture, still less out of doors. But even partial control would be very helpful. All these pests go through life cycles, which are being studied in great detail all over the world, and especially in the United States. Somewhere there occurs a state which is weaker or more easily controlled than others, and the pest would become harmless if the chain could be broken here or if the cycle could be sufficiently retarded to give the plant a chance of passing the susceptible stage before it is attacked.

The plants themselves, as we have just seen, are in some degree under control, and if they could be pushed through the susceptible stages before the pest was ready they would escape attack. Barley in England is sometimes considerably injured by the gout fly (*Chlorops tæniopus*). The larvæ emerge in spring from the eggs laid on the leaves

and invariably crawl downwards, entering the young ear if, as usually happens, it still remains ensheathed in leaves. J. G. H. Frew, at Rothamsted, has shown that early sowing and suitable manuring cause the ear to grow quickly above the track of the larvæ, and thus to escape injury. E. A. Andrews, in India, has found that tea bushes well supplied with potassic fertilizer escape attack from the mosquito bug (*Helopeltis*) for the rest of the season, apparently because bushes so treated become unsuitable as food to the pest. And further, the conditions are alterable. H. H. King in the Sudan has effected some degree of control of the cotton thrips (*Heliothrips indicus*) by giving the plant protection against the drying North wind and so maintaining a rather more humid atmosphere—a condition in which the plant flourishes more than the pest. Tomatoes in England suffered greatly from *Verticilium* wilt till it was found that a small alteration of temperature threw the attack out of joint. They are also much affected by stripe disease (*B. lathyri*), but they become more resistant when the supply of potash is increased relative to the nitrogen. It has recently been maintained, though the proof is not yet sufficient, that an altered method of cultivating wheat in England will afford a good protection against bunt. These cultural methods of dealing with plant diseases and pests offer great possibilities, and a close study jointly by plant physiologists and pathologists of the responses of the plant to its surroundings, and the relationships between the physiological conditions of the plant and the attack of its various parasites, would undoubtedly yield results of great value for the control of plant diseases. Again, however, the plant breeder can save a world of trouble by producing a variety resistant to the disease; or there may fortunately be found an immune plant from which stocks can be had, as in the case of the potatoes found by Mr. Gough to be immune to the terrible wart disease.

Control of Environmental Factors.

It thus appears that, if only plant breeders and plant physiologists could learn to alter existing plants or to build up new plants in such a way that they should be well adapted to existing soil and climate conditions, and not adapted to receive disease organisms at the time the organisms are ready to come—if only they could do this all agricultural land would become fertile and plant diseases and pests would become ineffective: at any rate until the pests adapted themselves

to the new plants. Although no one can set limits to the possibilities of plant breeding and plant physiology, we cannot assume that we are anywhere near this desirable achievement or that we are likely to be in our time. There will always remain the necessity for altering the environmental conditions for the growth of the plant. No attempt is yet made in the field to control two of the most important of the factors ; the light and the temperature, though it is being tried experimentally. There is a great field for future workers here ; at present plants utilize only a fraction of the radiant energy they receive. At Rothamsted attempts have been made by F. G. Gregory to measure this fraction ; the difficulties are considerable, but the evidence shows that our most efficient plants lag far behind our worst motor-cars when regarded as energy transformers for human purposes. One hundred years ago the efficiency of an engine as transformer of energy was about 2 per cent ; now, as a result of scientific developments it is more than 30 per cent. To-day the efficiency of the best field crops in England as transformers of the sun's energy is about 1 per cent*; can we hope for a similar development in the next hundred years ? If such an increase could be obtained an ordinary crop of wheat would be about 400 bushels per acre, and farmers would feel sorry for themselves if they obtained only 200 bushels. But we are only at the beginning of the subject. Increases in plant growth amounting to some 20 or 25 per cent have been obtained by V. H. Blackman in England under the influence of the high-tension electric discharge, which presumably acts by increasing in some way the efficiency of the plant as an energy transformer. Possibly other ways could be found. It needs only a small change in efficiency to produce a large increase in yield. Much could be learned from a study of the mass of data which could be accumulated if agricultural investigators would express their results in energy units as well as in crop yields as at present.

Interesting results may be expected from the attempts now being made in glasshouse culture both in Germany and at Cheshunt to increase the rate of plant growth by increasing the concentration of the carbon dioxide in the atmosphere.

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* The remaining energy being largely used up in transpiration. This figure refers to the total radiation received by the Chloroplast surface. For this latter the value is much higher.

Control of the Soil Factors.

The soil factors lend themselves more readily to control and much has been already achieved. Water supply was one of the first to be dealt with. Civilization arose in the dry regions of the earth, and as far back as 5,000 years ago irrigation was so advanced as a practical method that it came into the ordinances drawn up by the great Babylonian king Hammurabi. The chief problems at the present time are to discover effective means of economizing water and to ascertain, and if possible control, the relationships between the soil, the water, and the dissolved substances in the water. Economical use of water is necessary because it allows larger areas to be irrigated, and because water beyond a certain amount injures the soil and asphyxiates the plant roots. This part of the problem is largely one of engineering and police control. The more serious problem, perhaps the most serious, confronting agricultural science to-day, is that presented by the soluble matter in the water and the soil. The terrible spectre of alkali looms ahead of every irrigation project ; it may be kept under control for a longer or shorter period or it may completely wreck the scheme. Instances could be multiplied of schemes started with great expectations of results yet yielding only disappointment and loss. A volume could be filled with the tragedies of the alkali problem. Neutral salts, particularly sodium sulphate, are not harmful to plants unless their concentration exceeds a certain critical value ; indeed, some of the heavy soils in dry countries, as in Egypt and the Sudan, become unworkable if washed with pure water ; they remain flocculated only because some soluble salts are present. Chlorides beyond a critical concentration are more harmful to the plant, but sodium carbonate is deadly, and there is no certain way at present of overcoming its effects.

The empirical method has apparently gone as far as it can, and nothing more can be expected until some fresh opening is discovered by scientific workers.

Almost equally important is the more efficient utilization of water in districts where the rainfall is sufficiently high to obviate the need for irrigation, but sufficient to allow of any wastage of water. The practical work of the Utah agriculturists as exemplified by Widstoe, and the laboratory results of Keen at Rothamsted, all indicate that something can be done. It is legitimate to hope that the next great

advance will come from Canada, where in the West there are admirable opportunities for studying the problem.

Inseparably bound up with water supply are the questions of cultivation and of drainage, which affect not only the water but the air supply to the roots. This former subject is now attracting considerable attention : the great need is to discover means for expressing cultivation in exact physical and engineering units. The measurements of Keen and Haines at Rothamsted, and the chemical work of A. F. Joseph, N. Comber and others on clay, and of Oden, Page and others on humus, indicate the possibility of finding exact expressions and of effecting co-operation with the workers in the new fields of agricultural engineering.

Another soil factor which readily lends itself to some degree of control is the amount of plant nutrients present. The possibility of increasing this by means of manure has been so frequently explored in field trials that it has sometimes been regarded as almost a completed story ; indeed, Rothamsted tradition affirms that Lawes himself once gave orders to have the Broadbalk field experiments discontinued because they had nothing further to tell ; it was only the earnest persuasion of Gilbert that caused him to countermand the order. So far from the subject being exhausted, it still bristles with problems. The new nitrogenous fertilizers, resulting from war-time activities in nitrogen fixation ; the need for reducing the cost of super-phosphate ; the change in character of basic slag ; and the Alsatian development in potash production are producing changes in the fertilizer industry the full effects of which are not easy to foresee. Economic pressure is driving the farmer to derive the maximum benefit from his expenditure on fertilizers, lime, farmyard manure and other ameliorating agents, and is compelling a more careful study of possibilities hitherto disregarded, such as the use of magnesium salts, silicates, and sulphur as fertilizers, and, above all, a much more precise diagnosis of soil deficiencies than was thought necessary in pre-war days.

But there are more fundamental problems awaiting solution. It is by no means certain that we know even yet all the plant nutrients. The list compiled by Sachs many years ago includes all needed in relatively large amounts, but Habriel Bertrand has shown that it is not complete and that certain substances—he studied especially manganese—are essential, although only in very small amounts,

Miss Katherine Warington, working with Dr. Brenchely at Rothamsted, has shown that leguminous plants fail to develop in the so-called complete culture solution unless a trace of boric acid is added. Mazé has indicated other elements needed in small amounts.

Another problem needing elucidation is the relationship between the quantity of nutrients supplied and the amount of dry matter produced. Is dry matter production simply proportional to nutrient supply, as Liebig argued, with the tailing off beyond a certain point, as demonstrated by Lawes and Gilbert, or is it always less than this, as indicated by Mitscherlich's logarithmic curve, or is the relationship expressed by one of the more complex sigmoid curves as there is some reason to suppose? We do not know; and the problem is by no means simple, yet it governs the "diminishing returns" about which farmers now hear so much. Again, very little is known of the relationship between nutrition and period of growth. One and the same quantity of a nitrogenous fertilizer, for example, may have very different effects on the plant according as it is given early or late in life; not only is there a difference in quantity of growth, but also in the character of the growth. Late dressings cause the characteristic dark-green colour to appear late in the season, and thus affect the liability to fungoid diseases; they increase the percentage of nitrogen in the grain and they may give larger increases of crop than early dressings.

Investigations are needed to find the best methods of increasing the supply of organic matter in the soil and its value for the different crops in the rotation.

All these problems will sooner or later find some solution. But there remains a greater problem of more importance than any of them: the linking-up of plant nutrition studies with those of the soil solution. As our cousins in the United States were the first to emphasize, the fundamental agent in the nutrition of the plant is the soil solution, and they have made a remarkable series of investigations into what appeared at one time a hopeless proposition—the physico-chemical interactions between the soil and the soil water. Whitney and Cameron began the work, and it has gone on with much controversy—as important scientific investigations always do—and it is now being attacked with much vigour by some of the younger scientific workers, particularly in the Californian school; Burd, Hoagland, Kelley,

Lipman, Stewart, Sharp, and others. There is also some valuable work by Gola and other Italians. The natural soil solution is not always the best for the growth of plants. It is reasonable to suppose that the most efficient method of using fertilizers would be for making up the soil solution to the optimum composition and concentration for each stage of the growth of the crop. Unfortunately, this cannot yet be done. The added fertilizer does not simply increase the concentration of the soil solution to the precise extent that might be expected ; there are interactions, absorptions, and base exchanges of the kind studied first by Way, much later by van Bemmelen and by Gedroiz, and more recently by Hissink and by Wiegner. Further, the plant relationships are not constant ; there is apparently—though this is not certain—more response to certain nutrients at one time of its life than at another. A great advance in crop production may be expected when the soil chemists have discovered the laws governing the soil solution, when the plant physiologists can give definite expression to the plant's response to nutrients, and when someone is able to put these results together and show how to alter the soil solution so that it may produce the maximum effect on the plant at the particular time. The new soil chemistry will yet have its triumphs.

The Soil Micro-Organisms : Can They be Controlled ?

It is now more than forty years since the discovery of the great importance of micro-organisms in determining soil fertility. Practical applications necessarily lag far behind : but already three have been made each of which opens out great possibilities for the future. The long-standing problem of inoculation of leguminous crops with their appropriate organisms has already been solved in one or two of its simple cases, chiefly lucerne on new land, and the new process has helped in the remarkable extension of the lucerne crop in the United States and in Denmark. We believe at Rothamsted that the more difficult English problem is now solved also. Interesting possibilities are opened up by the observation that a preliminary crop of Bokhara clover seems to facilitate the growth of the lucerne.

The organisms effecting decomposition are now coming under control, and are being made to convert straw into farmyard manure (or a material very much like it) without the use of a single farm animal. The process was worked out at Rothamsted, and is being developed

by the Adco Syndicate, who are now operating it on a large scale and are already successfully converting some thousands of tons of straw annually into good manure.

The third direction in which control of the soil organisms is being attempted is by partial sterilization. This process is much used in the glasshouse industry in England, and it has led to considerable increases in crop yields. The older method was to use heat as the partial sterilizing agent, and this still remains the most effective, but owing to its costliness efforts have been made to replace it by chemicals. Considerable success has been attained ; we have now found a number of substances which seem promising. Some of these are by-products of coal industries ; others, such as chlor- and nitro-derivatives of benzene or cresol, are producible as crude intermediates in the dye industry.

The Need for Fuller Co-operation.

Looking back over the list of problems it will be seen that they are all too complex to be completely solved by any single worker. Problems of crop production need the co-operation of agriculturists, plant physiologists, soil investigators, and statisticians. Even plant breeding necessitates the help of a physiologist who can specify just what the breeder should aim at producing. And this gives the key-note to the period of agricultural science on which we have now entered—it is becoming more and more a period of co-operation between men viewing the problem from different points of view. Good individual work will, of course, always continue to be done, but the future will undoubtedly see a great expansion of team work such as has already led to important results in medical research, and such as we know from our experience at Rothamsted is capable of giving admirable results in agricultural science.

The team work should not be confined to individuals working at the same institution. The world would gain greatly if co-operation such as now exists between the Imperial College Botany School and Rothamsted could be effected between other great institutions devoted to agricultural science in the various countries of the world. To take only one illustration : how much could be accomplished in the study of the very difficult alkali problem if it were possible to organize a team representing such great agricultural stations as, for instance, California and Utah, the Departments of Agriculture of India and other

of the great Dominions affected, Rothamsted, Hissink's School, with power to lay down experiments anywhere and money to carry them out. And if extended co-operation of this kind should prove impossible of attainment, much could be done by fostering co-operation between the Agricultural Institutions of the Empire. There are certain great problems which are common to large parts of the Empire where the experience of one part would be of great value to the rest. The institutions in Britain, for example, have experience of problems connected with land long since settled and brought into cultivation, where men must produce 40 or more bushels per acre of wheat and 6 to 10 tons per acre of potatoes to make these crops pay, and where animal husbandry must be run on sound and economic lines. Canada has an unrivalled experience with wheat, and in the Western Provinces has a magnificent chance for studying one of the most important problems of the day—the water supply to the crop. Australia, New Zealand, South Africa, East, West, and Tropical Africa, India, and the West Indies—to mention only a few in the great family that forms the British Empire—all have their special lines in agricultural development ; each has some achievement that can be shown with pride and in the certainty that its study will benefit others. The Empire has already its Conference of Premiers, why should it not have its conference for agricultural science and practice ?

With fuller co-operation both of men and of institutions we could do much to overcome the present difficulty in regard to utilizing the information we already possess. In the last thirty years an immense stock of knowledge has been obtained as to soils and crops—knowledge that ought to be of supreme value in interpreting the facts of Nature as shown in the field. It is stored in great numbers of volumes which line the shelves of our libraries, and there much of it rests undisturbed in dignified oblivion. In the main it consists of single threads followed out more or less carefully ; only rarely does some more gifted worker show something of the great pattern which the threads compose. But even the most gifted can see but little of the design ; the best hope of seeing more is to induce people to work in groups of two or three, each trained in a different school and therefore looking at the problem from a different point ; each seeing something hidden rom the rest. Unlike art, science lends itself to this kind of team

work; art is purely an individual interpretation of Nature while science aims at a faithful description of Nature, all humanistic interpretation being eliminated. There is certainly sufficient goodwill among the leaders of agricultural science to justify the hope of co-operation; there are probably in existence foundations which would furnish the financial aid.

And that leads to my last point. What is the purpose of it all? Team work, co-operation, the great expenditure of time and money now being incurred in agricultural science and experiment—these are justified only if the end is worthy of the effort. The nineteenth century took the view that agricultural science was justified only in so far as it was useful. That view we now believe to be too narrow. The practical purpose is of course essential; the station must help the farmer in his daily difficulties—which again necessitates co-operation, this time between the practical grower and the scientific worker. But history has shown that institutions and investigators that tie themselves down to purely practical problems do not get very far; all experience proves that the safest way of making advances, even for purely practical purposes, is to leave the investigator unfettered. Our declared aim at Rothamsted is "to discover the principles underlying the great facts of agriculture, and to put the knowledge thus gained into a form in which it can be used by teachers, experts and farmers for the upraising of country life and the improvement of the standard of farming."

This wider purpose gives the investigator full latitude, and it justifies an investigation whether the results will be immediately useful or not—so long as they are trustworthy. For the upraising of country life necessitates a higher standard of education for the countryman; and education based on the wonderful book of Nature which lies open for all to read if they but could. How many farmers know anything about the remarkable structure of the soil they till, of its fascinating history, of the teaming population of living organisms that dwell in its dark recesses; of the wonderful wheel of life in which the plant takes up simple substances and in some mysterious way fashions them into foods for men and animals and packs them with energy drawn out of the sunlight—energy which enables us to move and work, to drive engines, motor-cars, and all the other complex agencies of modern civilization? No one knows much of these things;

but if we knew more and could tell it as it deserves to be told, we should have a story that would make the wildest romance of human imagination seem dull by comparison, and would dispel for ever the illusion that the country is a dull place to live in. Agricultural science must be judged not only by its material achievements, but also by its success in revealing to the countryman something of the wonder and the mystery of the great open spaces in which he dwells.—*Chemistry and Industry, Vol.* 43, *No.* 36, *September* 1924.

BACK NUMBERS.

A few copies of the following back numbers of the Journal of the Mysore Agricultural and Experimental Union are wanted by the Union. Members or subscribers who can spare their copies are requested to send them to the Secretary, the Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore, by book post. If desired each copy will be paid for at 8 annas on receipt.

Vol. I, No. 1, 1919.

Vol. III, No. 4.

Vol. IV, Nos. 1, 2 and 3.

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The Mysore Agricultural and Experimental Union.

Programme of Experimental Work for 1925.

CIRCULAR.

The Department of Agriculture desires to arrange with members of the Union for the carrying out of the following experiments during the coming season :—

1.—Experiments with Implements.

Trial of the Mysore plough as manufactured at the Bhadravati Iron Works, in comparison with any other type of improved plough, preferably the Kolar Mission plough.

2.—Experiments with Seeds.

Trial of selected strains of —

(*a*) Ragi—seed enough for 3 guntas each of two of the new varieties will be supplied.

(*b*) Groundnut—seed enough for 3 guntas each of two new varieties will be supplied.

(*c*) Castor—seed enough for 3 guntas each of any two varieties will be supplied.

(*d*) Cotton :

(1) Doddahatti—seed enough for 3 guntas will be supplied.

(2) Sannahatti—seed enough for 12 guntas each of two varieties will be supplied.

(Only members in cotton tracts need apply.)

(*e*) Paddy—seed enough for 3 guntas each of any two varieties will be supplied, the varieties to be selected by the member on the basis of information supplied by the Agricultural Department.

(*f*) Sugarcane—seed enough for one gunta each of two Hebbal seedling canes will be supplied. Arrangement for the conveyance of seed setts from the nearest Railway Station should be made by the member indenting for them. Application for sugarcane setts should be made immediately.

Conditions of Supply of Seed.

1. The seed of each variety shall be sown in separate plots with check plots arranged as per instructions sent with the seeds.

2. The results of experiments shall be reported after harvest in the form which will be supplied.

3. The experiments shall be conducted for at least three years, seed for the second and subsequent sowings being reserved from the first supply by the Agricultural Department.

3.—Experiments with Manures.

(1) Ammonium Sulphate on Sugarcane. Between 12 and 20 guntas of land will be required. Ammonium Sulphate intended for experiment will be supplied at cost price ; the value of manure for experiment may not exceed Rs. 25.

(2) Manuring of paddy with Oil-cake and Super-phosphate or Bonemeal and Sulphate of Ammonia—not less than 10 guntas of land will be required. The manure intended for experiment will be supplied at cost price ; the value of manure per experiment may not exceed Rs. 5.

4.—Experiments on the Control of Insect Pests.

(*a*) Sugarcane Borer.
(*b*) Pests of Stored Pulses.
(*c*) Coffee Borer.
(*d*) Cardamom Caterpillar.

5.—Experiments on the Control of Fungus Diseases.

Black Rot of Coffee—Spraying material and sprayers will be supplied by the Department. The labour to be supplied by the member.

6.—Experiments on Fodder Conservation.

Use of Sunflower for ensilage Seed for one acre will be supplied.

7.—Sericultural Experiments.

Rearing.—Experimental Rearing with seed of new races of Silkworms. 100 layings of eggs of selected new races will be issued free for each of 3 experimental rearings on condition that the rearing shall be conducted according to written instructions which will be issued by the Department, and that a report shall be furnished in the form which will be supplied. The cocoons must be sold to the Department who will give 10% above market rates.

Reeling.—Newly designed reeling machines will be lent for 3 months free of charge on condition that they shall be used for reeling at least 10 lbs. of silk and that a report shall be furnished of results in the form prescribed by the Department. The experimenter may, with the consent of the Superintendent of Sericulture, sub-lend the machine, subject to the same condition. A demonstrator will be sent to instruct the experimenter in the use of the reeling machine.

8.—Maintenance of Farm Accounts.

Maintaining accounts on the model of the forms drawn up by the Union at the IV Annual Meeting. A sample copy of the model forms will be supplied on requisition.

Application from members intending to undertake the experiments should be made to the Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore, on the following form, the particular experiment or experiments they desire to undertake being specified by being ticked off on this circular. The seed, manure, etc., will be supplied in the order in which the application is received *as long as the stock lasts.*

BANGALORE,
31—12—1924.

LESLIE C. COLEMAN,
President,
The Mysore Agricultural and Experimental Union.

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7. The Tropical Life, London.
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9. The Modern Review, Calcutta.
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11. The Mysore Engineers' Association Bulletin, Bangalore.
12. The Painter, Kuala Lumpur, Federated Malay States.
13. The Malayan Agricultural Journal, Federated Malay States.
14. The Agricultural Gazette of New South Wales, Australia.
15. The Review of Applied Entomology, London. (Agricultural Series.)
16. Bulletins of the Deli Experiment Station, Sumatra.
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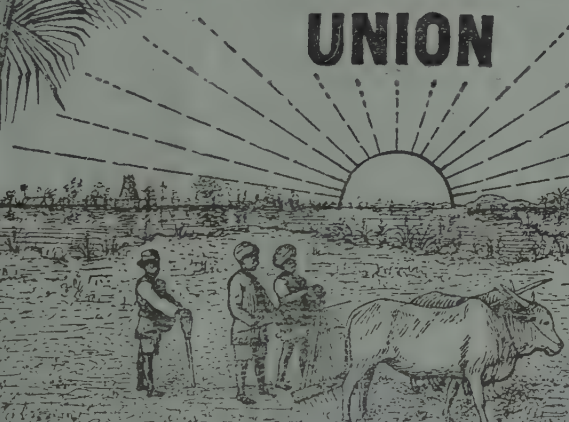

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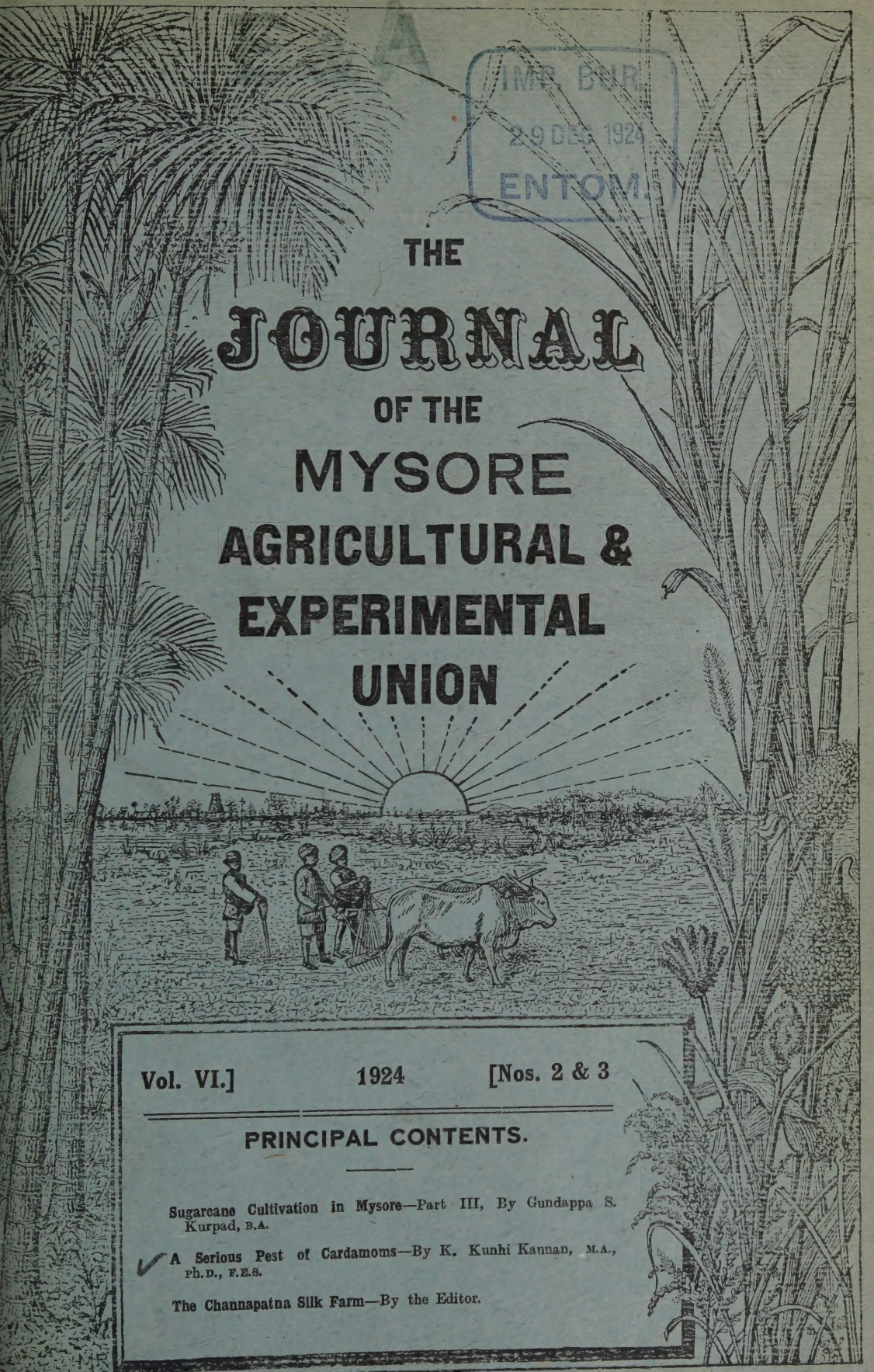

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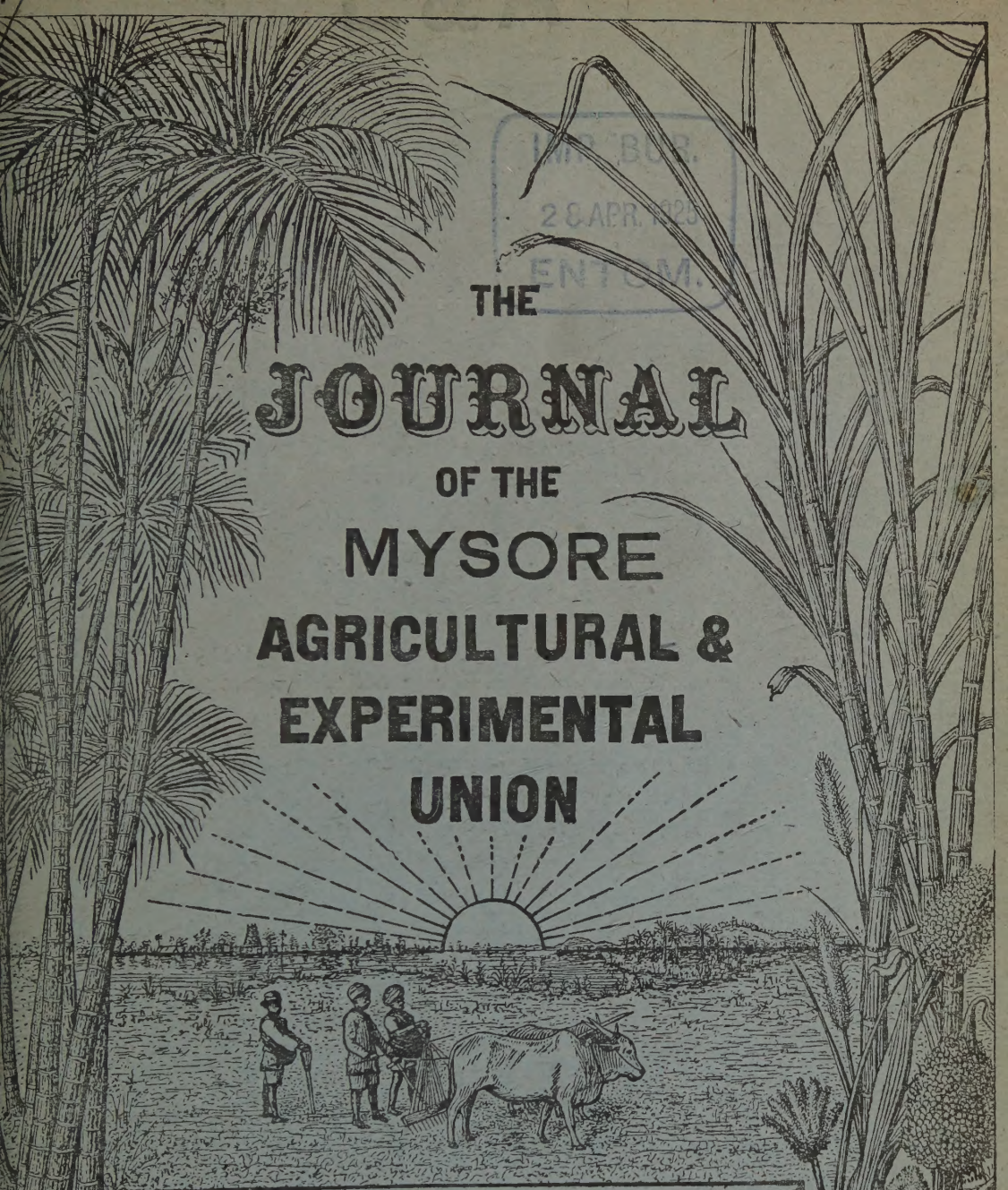

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